ESTABLISHED 1916 as The OIL WEEKLY
JUL 11 1950
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WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING, PRODUCING, PIPE LINE OPERATIONS AND MANAGEMENT

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ROCK BITS

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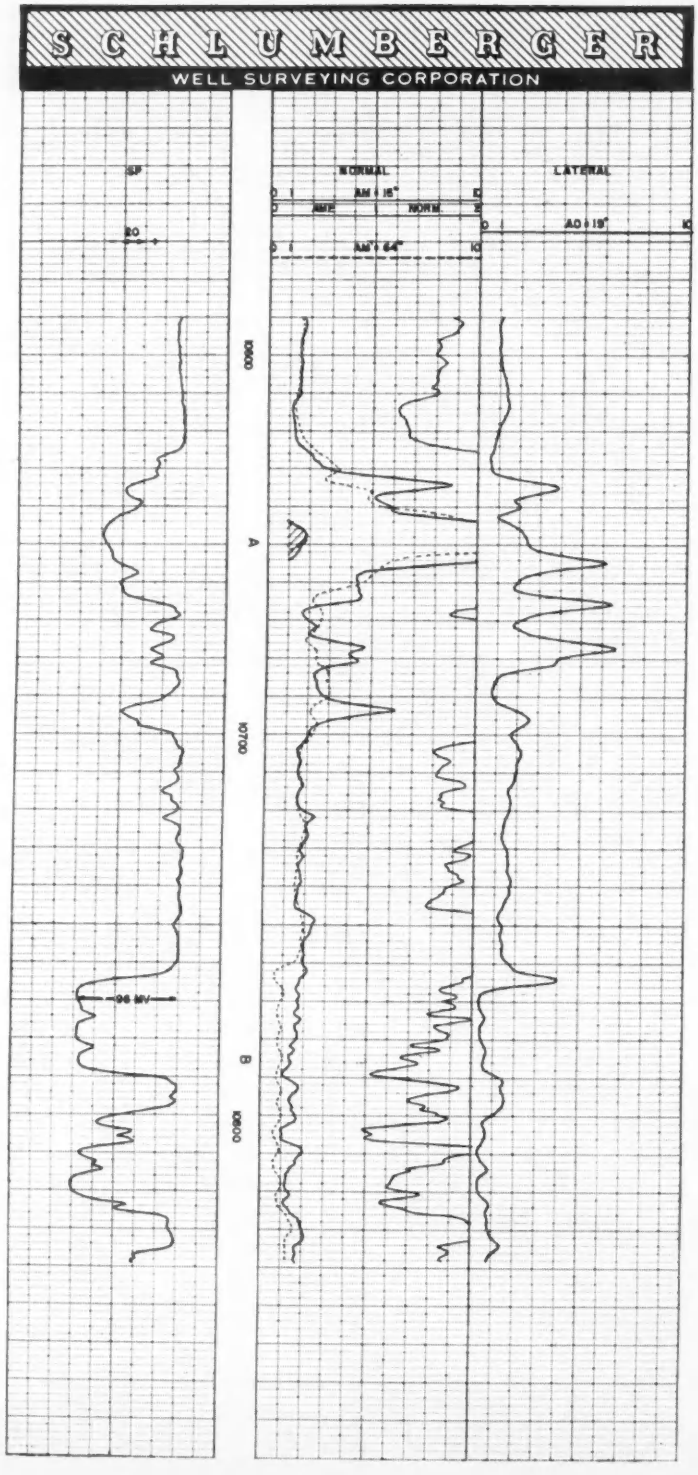
MIOCENE SAND
IN POINTE A LA HACHE FIELD
PLAQUEMINES PARISH, LA.

Mud (Baroid):
R_m = 0.92 ohms at BHT
Bit Size: $9\frac{7}{8}$"
Spacings: AM = 16"
AM' = 64"
AO = 19'



LOG ANALYSIS

1) Water saturation S

R_o = 0.8 ohm in water sand around B level

The value of 20 ohms given in level A by both the 16" and 64" Normal when corrected will result in R_t = 27 ohms approx.

In level A $S = \sqrt{\frac{0.8}{27}} = 17\%$ approx.

2) Formation water resistivity R_w

$SP = -90 \log_{10} \frac{R_m}{R_w} = -96$ mv.,

thus, R_w = 0.08 ohm BHT

3) Porosity p

$F = \frac{R_o}{R_w} = \frac{0.8}{0.08} = 10$

$p = \sqrt[m]{\frac{1}{F}} = 28\%$ for m = 1.8

CORE ANALYSIS

Porosity	26 to 34%
Permeability	1800 md.

PRODUCTION RESULTS

Perforated	10,669-80 and 10,689-93 with 24 shots
Potential	240 BOPD, 34° API Gas oil ratio 675/1

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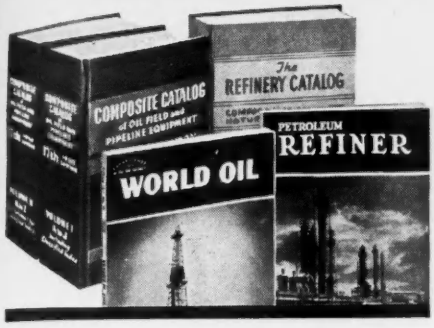
WELL SURVEYING CORP.
HOUSTON, TEXAS



Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
3301 Buffalo Drive, Houston 6, Texas
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for the drilling-producing-pipe line industry

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for the refining-natural gasoline industry

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Published every month except semi-monthly in February and July. Single copies 50 cents (except special issues). Subscription price: domestic and foreign, $2 a year; 2 years, $3; 3 years, $4. Advertising rates on application.
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Indexed by Industrial Arts Index and Engineering Index

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WORLD OIL
Established 1916 as THE OIL WEEKLY

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how do you buy a good oil field service

Service itself is intangible. When you buy an oil field service, you buy only expected *results*. But you don't see the results until after the service is bought and performed. So how do you buy *good* service . . . service that gives results?

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Editor's Page

SUSPICIONS MULTIPLY

AS CONTRADICTORY CHARGES and countercharges continue to be hurled about over the question of whether disloyal persons are working in high U. S. government positions, only 2 things become certain in the whole affair. One of these certainties is that confusion and suspicion grow day by day. The other certainty is that it is indeed a sorrowful and disgraceful thing for any person or group of people to place political party considerations above the welfare of the nation, which is done when the matter is not given an honest and deep non-partisan probing so it can be settled conclusively for the benefit of the American people.

With such sordid examples as Alger Hiss, Gerhart Eisler, Julius Wadleigh, Judith Coplon, Klaus Fuchs, the Amerasia case and others so recent they cannot be forgotten, the vociferous defense of accused or suspected employes by some government officials only adds to the suspicion. Was not Alger Hiss cleared by loyalty checks and protected by high ranking government officials for 9 long years?

Surely it is not asking too much of any government department to submit its files, secret or otherwise, so Congress can reach a decision on guilt or innocence on a subject of such vital interest to the nation. The excuse that submitting secret documents will imperil national security is not convincing, when on the other hand the nation's security definitely is placed in jeopardy if a single communist is working in any top governmental department. Furthermore, it seems preposterous that congressmen, who are elected to be guardians of national security, cannot be trusted with secret information when an essential issue of this nature is at stake.

Rightly or wrongly, under the circumstances, the American people can only think that matters are being "covered up" by the refusal to furnish the investigating committee with records. This is a condition which breeds a feeling of guilt by implication.

There is no place for political maneuvering or for complacency in such a situation. Those who hinder the progress of a deep and honest probe are guilty of gross misconduct against this country.

THE PEOPLE RESPONSIBLE

A GREAT MANY PEOPLE are upset because the U. S. Supreme Court has ruled against Texas and Louisiana in the tidelands oil case, thus following the example established in the California suit in 1947.

This is as it should be, and the people should not be hesitant to voice their views, for this is not a battle for tidelands alone. It is a much bigger issue. It is a fight for state rights, for constitutional rights, for individual freedoms, and for checking the increasing authority of the federal government.

The decisions have not been based on ownership, but upon "paramount rights" resulting from the necessity of the federal government's protecting the marginal seas. If for this reason the federal government can seize the tidelands, it can also seize iron ore and all other natural resources helpful in defending the country. This raises the question as to the limits of national security as an excuse for extending federal authority, since the government is responsible for protecting all property—even the homes of the people. It is to be hoped that a sufficient number of people are aroused to awaken additional senators and congressmen to the inherent danger.

However, the decision from the Roosevelt-Truman appointed Supreme Court should not be surprising to anyone. When the people voted Harry Truman into office in 1948, they knew federal ownership of the tidelands was a top plank in his platform. His views on this subject received wide publicity during the 1948 campaign. Consequently, the voters gave him a "go" signal when they elected him president.

Therefore, the people are responsible for the loss of the tidelands because they were not more careful with their votes in 1948.

Warren L. Baker

A RIG SIDE CHAT

about Baker Retainer Production Packers

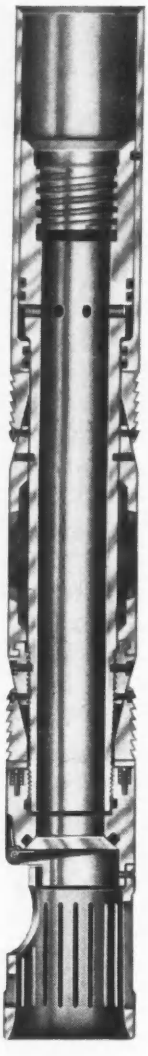
What we want to talk about today is how the Baker Production Packer is set securely in the casing, anchored against either upward or downward movement, with the tubing production string left free from the packer. The tubing is run through the body of the packer for production, and is free to be pulled at any time without disturbing the packer. In the typical application drawing (far right) the packer has been set and anchored to the casing by the two sets of opposing slips, with the Hycar packing unit sealed-off against the casing and retained in position by lead seals.

We want to produce from a zone below the packer so we make up the string with a Baker Perforated Production Tube on bottom (with operator's tubing to provide an additional stinger, if desired); above is a Baker Multi-V Tubing Seal Nipple; next a No Left Turn Latching Sub; and above that comes the tubing. Now we run-in the well until the Latching Sub engages in the top of the packer. The engaged Sub automatically positions the Multi-V Tubing Seal Nipple accurately in the smooth bore of the packer, and with 5 Hycar rings facing up and 5 more facing down, a perfect seal is obtained between the tubing string and the packer bore. Meanwhile, the Perforated Production Tube, as it was run through the bore of the packer, has unseated the Flapper Valve and now holds it in open position.

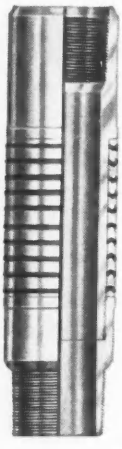
It's as simple as that, and we are ready to produce through the ⅜-inch holes in the Perforated Production Tube. These holes prevent junk, debris and large pieces of shale from entering and clogging the production string; and the total area of all holes is equal to or greater than the area of the tubing string.

When the tubing string is pulled at some future time, the Flapper Valve in the lower end of the packer body snaps back into the closed position and maintains a fluid-tight seal against upward pressure from below. The packer is not disturbed by pulling the tubing string, but remains packed-off against the casing ready for future operations.

This is only one of the many applications of the Baker Retainer Production Packer for single-zone or multiple-zone production; for selective testing and acidizing; for protection of casing from pressure or from destructive fluids, or gases; and other profitable uses.

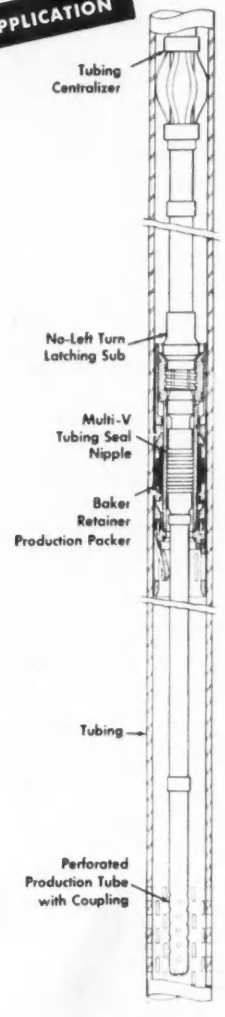


Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

TYPICAL APPLICATION



Single zone hook-up with production string anchored to packer, for: (a) keeping production string in tension to eliminate "tubing breathing" during the pumping cycle; (b) producing by flowing, without imposing excessive weight on packer to hold Tubing Seal Nipple positioned in packer bore; (c) making high pressure injection of gas or fluid for re-pressuring or secondary recovery.

Production string is run-in until No Left Turn Latching Sub rests on top of packer, indicated by drop in weight on strain gauge or weight indicator. The production string is then raised about 5 feet, and the zone washed and brought in, if it will flow.

If you would like to continue this rig-side chat at any well where you have a production packer problem, call the nearest Baker "Service Engineer." He will have helpful suggestions, and he is as near as your telephone . . .

Abilene 6820; Bakersfield 2-7487; Bay City 3328; Beaumont 4-5171; Brookhaven 1438; Casper 972; Cheyenne 2-4959; Cody 434; Coalinga 174; Corpus Christi 2-2251; Dallas, Riverside 4042; Duncan 3084; Elk City 188; Falfurrias 197-W; Great Bend 5681; Guymon 644; Harvey, (New Orleans Exchange) Uptown 3966; Hobbs 889-R; Houston, Wayside 2107; Kilgore 688; Lake Charles 6-5304; Levelland 246-J; Los Angeles, JEfferson 8211; Magnolia 980; Natchez 181; Newcastle 379; Odessa 4932; Oklahoma City 58-4445; Olney 482; Santa Maria 648-W; Scott, Lafayette 2219-W; Shreveport 4-1724; Taft 5-2355; Thermopolis 248-J; Tulsa 2-8083; Ventura, Miller 3-3800; Victoria 314; Wichita Falls 2-4776.

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BAKER

RETAINER PRODUCTION PACKER

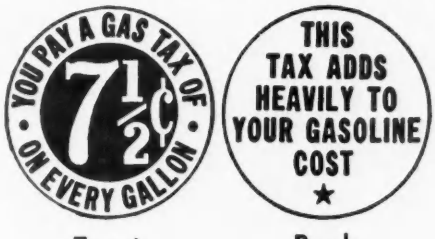
PRODUCT NO. 415-D

The Changing Panorama

"Tax Teller Coin" to Show Gasoline Cheap

THE "TAX TELLER COIN" has been made available to the industry as an effective way to make the gasoline-buying public realize that gasoline is cheap but made to appear high by heavy taxes. Marketing companies are urged to purchase the "coins" and make them available to retail outlets.

The idea is that of the American Petroleum Industries Committee of the American Petroleum Institute, 50 West 50th Street, New York 20, N. Y. The cardboard "coin" is intended to be handed out to service station customers



Front Back

with their change. Its purpose is to impress upon the industry's customers the truth that gasoline is cheap, but the tax is high.

It is predicted that more than 75 million "Tax Teller Coins" will be purchased and distributed. They are quoted at $1010 per million, but lesser quantities will be made available to wholesalers and retailers at a cost of $1.05 per thousand. The coins ordered for a given state will show the correct amount of tax on gasoline in that state.

A public official recently boasted to a group of colleagues: "If a 1 cent gasoline tax is added, the people would never know unless we told them . . . they would just think the oil companies had increased the price again."

He was probably right, because a recent survey showed that (1) 60 percent of the people don't realize how much gasoline taxes cost them, and (2) since 1946, 200 percent more people feel that gasoline prices are too high.

Double XX's Litter Trail of Mr. Truman

HARRY TRUMAN'S veto of the Kerr Bill was just one of a series of double crosses that litter his exit from the Democratic organization and adoption of a left-fringe group known as the Americans for Democratic Action.

So declared Ray Tucker, veteran Washington newsman, last month in his syndicated column, "National Whirligig."

According to Tucker, this is the conclusion drawn by Truman's erstwhile colleagues as a result of his recent maneuvering for mass support at the polls.

Says Tucker: "His veto of the Myers-Walter-Lucas Bill restoring the basing-point system for heavy industries, as well as his disapproval of the Kerr Natural Gas Bill, gave them convincing evidence of his desire for a major, political realignment.

"In both instances, he disregarded the advice, the need and the pleas of his old friends in House and Senate, including the leadership in both chambers. And he did so after he had promised them without any if's, and's or but's that he would sign those measures.

"He was frightened off from keeping these pledges by ADA warnings that he might lose their support, if he signed them. He bowed before what he thinks is the stronger political wind."

This emphasizes a point made in a story on the Kerr Bill beginning on Page 46 of this issue of WORLD OIL. If the industry is to avoid brutal punishment under this administration, it must educate the public. The voices of logic and justice are unheeded by a president whose ears are tuned to the roar of pressure groups.

End of Co-Op's Tax Advantage Foreseen

CONGRESS APPARENTLY IS going to take action toward correcting the situation whereby cooperatives and charitable and educational institutions, through tax exemptions, engage in business at competitive advantage over ordinary business concerns. By avoiding payment of income taxes, those organizations and institutions not only are in position to undersell competitors but also by not bearing their share of the tax load, they make the tax burden on competitors heavier and make continuance of excise taxes more necessary.

In the revenue bill that is being worked on by the House Ways and Means Committee it is proposed to tax the business earnings of educational and charitable organizations and labor unions. Colleges and foundations which own and operate factories, hotels, radio stations, airports, department stores and other competitive commercial enterprises are scheduled to be taxed in the new revenue bill. Labor unions, building and loan associations, and mutual savings banks also are on the Way and Means list of loopholes to be closed.

The Tax Court recently declared that the income of C. F. Mueller Marconi Company was fully taxable, in spite of the company's ownership by tax-exempt New York University. The decision opens the way to taxation of many other companies which have been acquired by tax-free universities and charities.

Business activities of charitable and educational institutions total about $360 million a year, and their tax liability, at the competitive corporation rate, amounts to about $80 million.

Cooperatives also are partially included in the plugging of loop-holes that Congress is expected to approve as a way of raising new revenue to replace the money lost by slashing wartime excise taxes. The Ways and Means Committee tentatively has approved a 10 percent withholding tax on cooperative patronage dividends, estimated to produce between $20 and $30 million of new revenue.

The committee's tax experts recommended more drastic action, and various members of the group proposed taxation of unrelated business activities—for instance, the ownership of a 10-cent store by a poultry co-op, and the taxation of retained reserves. But perhaps because this is an election year, the committee deferred until next year action going the full way with the co-ops. It is reported the committee stands 19 to 6 in favor of full taxation of all cooperative earnings.

Cooperatives now do about $17 billion of business volume a year, make profits of more than $1 billion, and escape a tax liability of nearly $350 million. Collection of this tax not only would cure a competitive situation that is hurting small business but also would make possible a far bigger reduction of the onerous wartime excise taxes.

Prospects Continue to Improve

By RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

THE OIL INDUSTRY'S economic picture continues in excellent shape. The combination of low stock levels and materially enlarged demand has resulted in improved product prices despite recent pronounced upsurge in production and refinery operations. Present indications are that higher output and firm prices will continue throughout the gasoline consuming season which does not end until next October. Current trends do not indicate any troubles are likely with the change to winter consuming conditions; although this picture could be changed by excessive production and refining rates, as in the latter part of 1948, causing the accumulation of surplus stocks during the next three months. However, current signs of steady consumption gains presage only runaway output levels could cause such a drastic shift in the present very encouraging outlook.

• • •

THE GAIN IN DEMAND continues to exceed 1949 levels by greater margins than anticipated, and as a result stocks remain far below year ago volumes and at near minimum quantities although production and refinery runs have increased sharply during the past three months.

Enlarged refinery runs have boosted gasoline production substantially above 1949 rates, but motor fuel inventories have been reduced at a faster clip than last year since entering the gasoline consuming season April 1. Consequently, even gasoline stocks now are below 1949 levels, although they had been 7¾ million barrels larger on April 1. As of June 17 gasoline inventories were fractionally under the corresponding date of 1949, and demand has been running nearly 10 percent above in recent weeks.

Other principal refined products have been under 1949 volumes for some time. Mid-June found distillate stocks 13½ million barrels below the same period of last year. The difference between current distillate inventories and those of a year ago has been reduced in recent weeks, but this seems desirable as demand of late has been about 40 percent greater. Residual inventories now are 25 million barrels beneath 1949 quantities, whereas they were only 23½ million barrels smaller a month earlier. Meanwhile, residual fuel demand has been averaging around 15 percent more.

Crude stocks also are at low levels. Mid-June volumes were just under 240 million barrels, the same as at the close of March despite much larger producing rates.

THE RECENT SHARP GAIN in refinery runs and crude production has been compelled by the relatively low level of stocks and the enlarged demand. With the reduction of stocks now practically completed, a greater portion of the current demand must not be supplied out of current production.

Consequently, both crude production and refinery runs were at the highest level of the year in June, and will be even larger in July. June oil production averaged around 5⅓ million barrels daily, up 445,000 barrels since March and 427,000 barrels above year ago rates. Another gain of approximately 100,000 barrels per day is indicated for July, which would boost the coming month to a volume that would be 700,000 barrels more than produced in July, 1949. Meanwhile, refinery runs had climbed to 5,550,000 barrels daily in June compared with 5,162,000 barrels in 1949. This gain in crude runs necessarily boosted product output by substantial amounts, but the growth was needed to satisfy demand as indicated by stock trends.

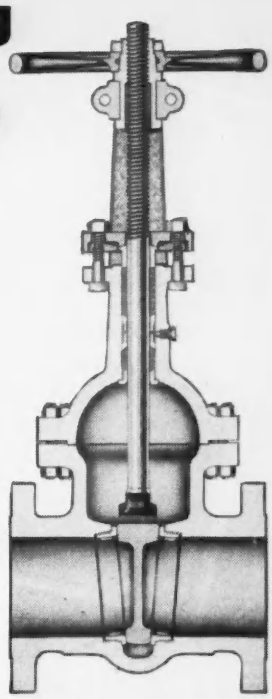
• • •

STRENGTHENED PRICES are especially significant in view of recent increased output. The basic reason is that demand has grown sufficiently to permit stock reductions despite enlarged production of both wells and refining plants. Better product prices have increased refinery profit margins, which combined with low crude stocks has caused a firming of the crude oil price structure which seemed to be in some jeopardy last March.

Group 3 distillate is selling at 7⅝ cents per gallon, and thus holding steady at peak winter levels although normally undergoing a distinct weakening during this off-consuming season of the year. For instance, in 1949 No. 2 fuel oil prices in Group 3 (Oklahoma) territory declined 2 cents from the winter peak of 8½ cents per gallon to 6½ cents per gallon in June. Meanwhile, Gulf Cargo No. 2 fuel oil advanced in early May from 6⅝ cents to 7 cents per gallon.

Gasoline prices have edged upward since early April. Oklahoma Group 3 prices for 82-octane motor fuel advanced ⅛ cent to 10⅛ cents per gallon in early June, and now compare with 9⅜ cents per gallon in early April. Gulf Cargo 86-octane now brings 10¾ cents per gallon against 9⅝ cents in early April.

For a bigger choice of better piping
Choose from the broad CRANE line



No. 33X, 300-Pound Steel Gate for oil or oil vapor up to 1100° F. Exelloy to Exelloy seating. Sizes: 1½ to 24-inch.

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Speaking of operating efficiency, the solid wedge disc in these valves is closely guided to assure accurate, tight seating and to reduce wear. Note, too, the Crane T-head disc-stem connection and two-piece ball-type gland that prevent side strain on stem and binding of working parts.

You'll find the Crane line of steel valves unusually complete: in pressure classes up to 2500 pounds, for temperatures up to 1100° F. Flanged, screwed, or welding ends. See your No. 49 Crane Catalog.

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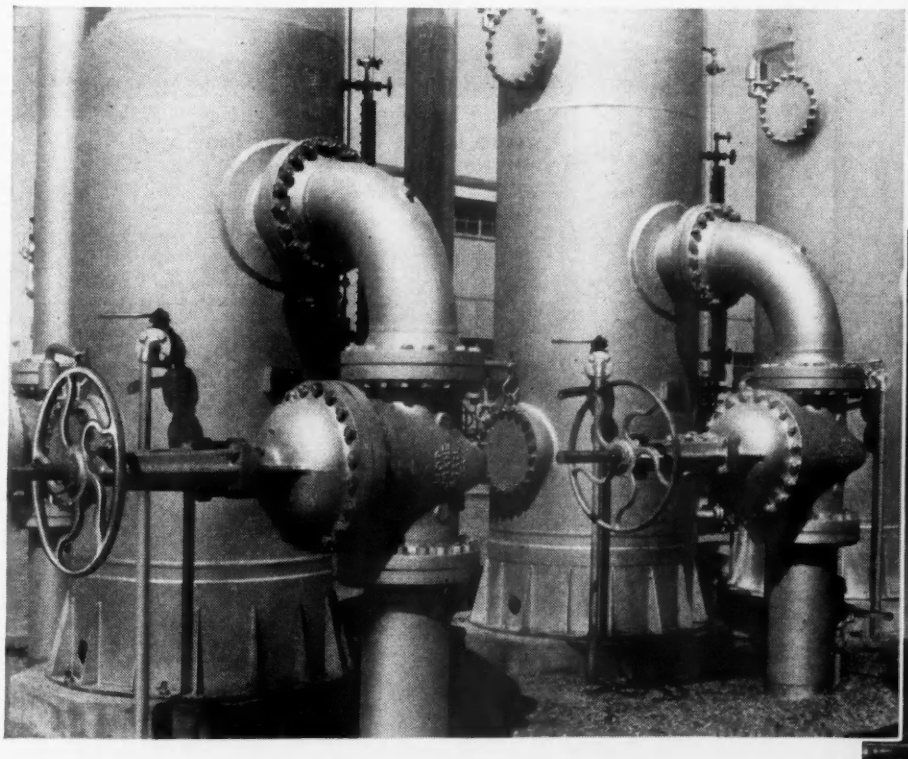
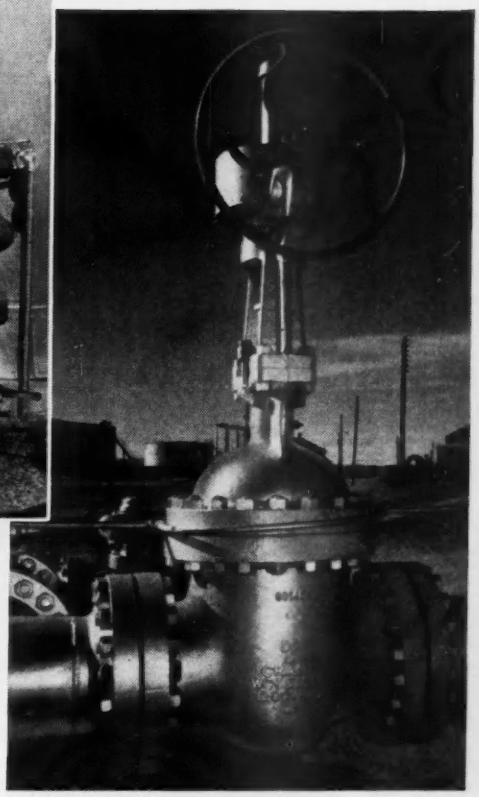


HIGH PRESSURE SCRUBBER LINES *to natural gasoline compressor station equipped with Crane 300-Pound Cast Steel Wedge Gate Valves.*

SCRAPER INLET JUNCTION *at crude oil pipe line station, featuring Crane 12-inch gear operated steel gate valve.*



EVERYTHING FOR EVERY PIPING SYSTEM

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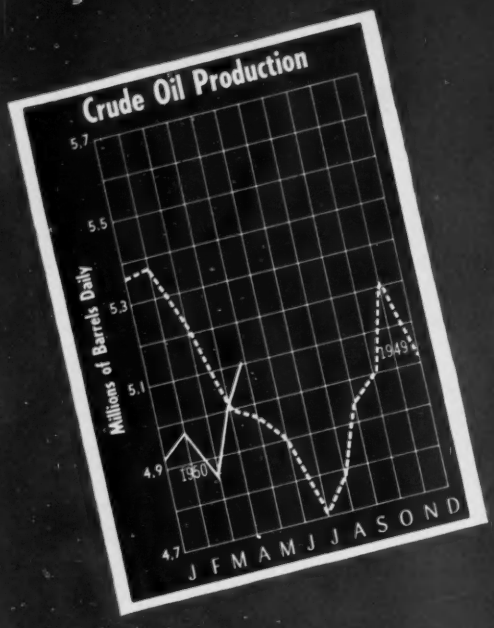
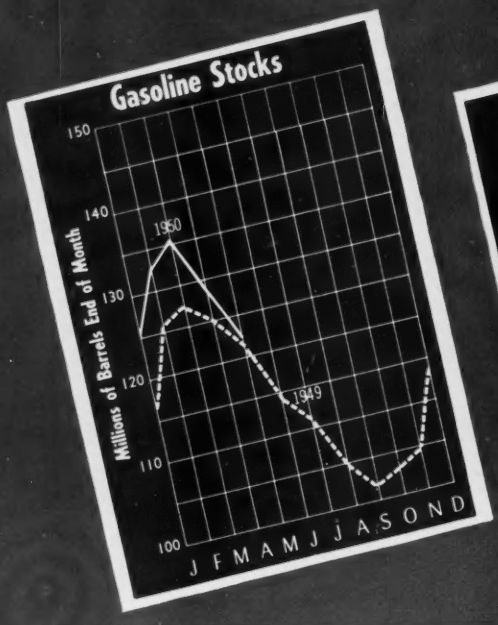
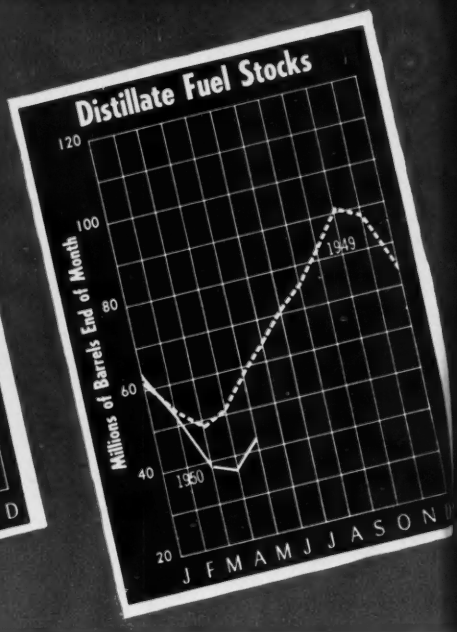
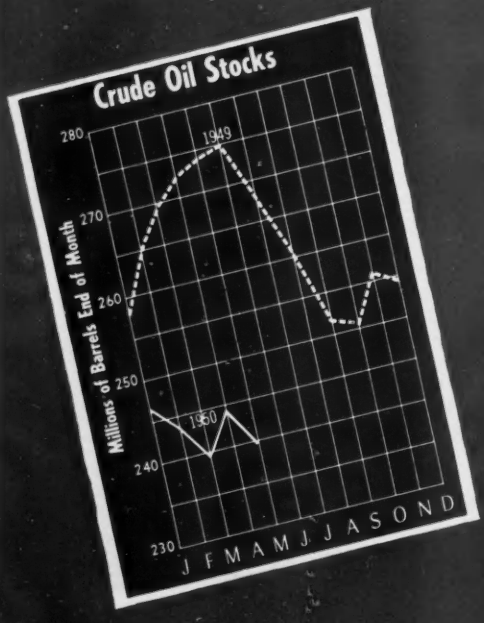
Petroleum

By CECIL W. SMITH
Statistical Editor







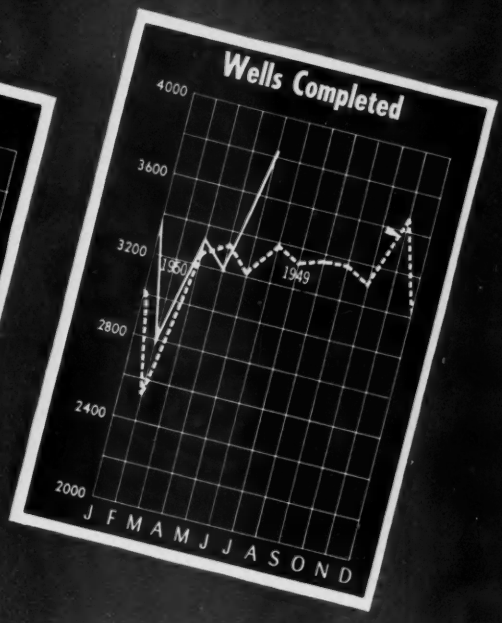


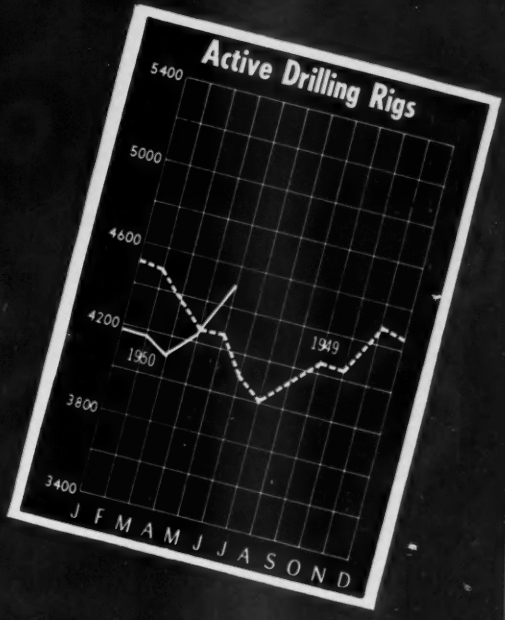
State Crude Oil Production

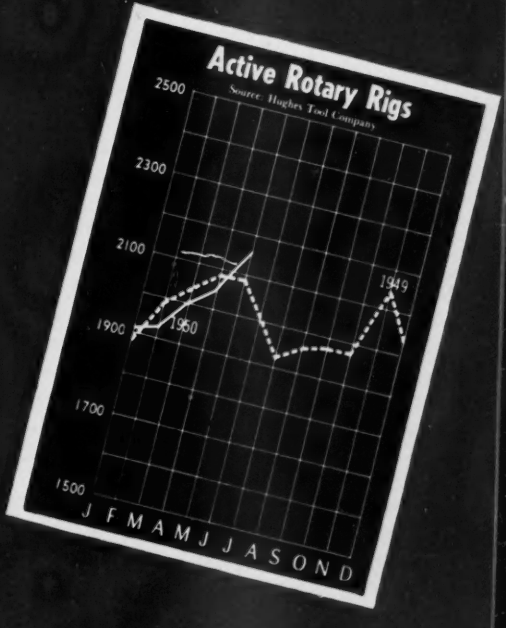
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST FIVE MONTHS		
	May, 1950	April, 1950	May, 1949	% Diff. May '49-'50	1950	1949	% Diff. '49-'50
Alabama	1.6	1.4	1.1	+ 45.5	233	181	+ 28.7
Arkansas	83.6	85.3	85.5	— 2.2	12,881	12,940	— 0.5
California	855.8	859.1	927.2	— 7.7	129,964	142,125	— 8.6
Colorado	59.2	59.0	64.7	— 8.5	9,040	9,837	— 8.1
Florida	0.9	1.1	1.3	— 30.8	152	191	— 20.4
Illinois	176.8	180.9	177.7	— 0.5	26,320	26,241	+ 0.3
Indiana	29.2	28.1	27.6	+ 5.8	4,056	3,611	+ 12 3
Kansas	276.5	268.5	285.5	— 3.2	41,845	43,848	— 4.6
Kentucky	26.3	25.8	23.2	+ 13.4	3,767	3,445	+ 9.3
Louisiana	549.2	535.2	534.8	+ 2.7	82,909	78,872	+ 5.1
North Louisiana	133.0	128.1	124.5	+ 6.8	19,166	18,617	+ 2.9
South Louisiana	416.2	407.1	410.3	+ 1.4	63,743	60,255	+ 5.8
Michigan	47.1	45.2	41.6	+ 13.2	6,846	6,764	+ 1.2
Mississippi	104.0	99.1	108.9	— 4.5	15,098	16,653	— 9.3
Missouri	0.1	0.1	0.1	.....	11	18	— 38.9
Montana	21.3	21.6	26.9	— 20.8	3,233	3,877	— 16.6
Nebraska	1.5	1.5	0.6	+ 150.0	263	96	+ 174.0
New Mexico	124.7	124.5	133.0	— 6.2	19,194	20,139	— 4.7
New York	13.9	13.6	11.3	+ 23.0	1,872	1,793	+ 4.4
Ohio	9.3	9.3	9.1	+ 2.2	1,391	1,394	— 0.2
Oklahoma	412.1	431.8	417.9	— 1.4	61,959	63,959	— 3.1
Pennsylvania	29.7	29.5	30.8	— 3.6	4,578	4,854	— 5.7
Tennessee	0.1	.....	.....	.....	10	3	+ 233.3
Texas	2,129.1	2,015.6	1,929.4	+ 10.4	300,753	323,149	— 6.9
Dist. 1—South Central	27 5	26.5	25.8	+ 6.6	3,985	4,016	— 0.8
Dist. 2—Middle Gulf	124.5	120.9	121.5	+ 2.5	17,792	21,459	— 17.1
Dist. 3—Upper Gulf	397.0	366.6	373.5	+ 6.3	55,922	63,555	— 12.0
Dist. 4—L. Gulf-S.W.	197.9	190.3	187.6	+ 5.5	28,244	31,269	— 9.7
Dist. 5—East Central	31.9	30.6	34.8	— 8.3	4,549	6,174	— 26.3
Dist. 6—Northeast	351.0	343.1	335.7	+ 4.6	49,355	57,084	— 13.5
Dist. 7-B—N. Central	67.1	63.3	56.9	+ 17.9	9,585	9,193	+ 4.3
Dist. 7-C—West Central	58.6	53.0	42.3	+ 38.5	7,800	6,953	+ 12.2
Dist. 8—West	643.2	601.1	520.7	+ 23.5	88,605	90,837	— 2.5
Dist. 9—North	139.0	130.8	126.1	+ 10.2	20,325	19,580	+ 3.8
Dist. 10—Panhandle	91.4	89.4	89.0	+ 2.7	13,645	13,377	+ 2.0
Utah	3.1	3.1	0.5	+ 520.0	455	37	+1129.7
Virginia	0.1	0.1	0.1	.....	12	16	— 25.0
West Virginia	8.0	8.0	7.6	+ 5.3	1,195	1,115	+ 7.2
Wyoming	154.3	158.9	126.0	+ 22.5	23,674	18,888	+ 25.3
Total United States	5,117.5	5,006.3	4,972.4	+ 2.9	751,711	784,046	— 4.1

n Trends in the U.S.







Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
March	5,406	5,387	234,164	2,252	111,949	1,050	30,570	1,307	34,192
April	5,484	5,540	234,506	2,396	109,289	978	32,564	1,303	35,527
May	5,502	5,668	231,318	2,486	108,552	992	38,551	1,314	41,123
June	5,544	5,632	231,412	2,529	104,518	998	45,835	1,280	44,213
July	5,522	5,631	230,955	2,494	98,839	994	56,045	1,264	49,448
August	5,577	5,621	231,954	2,532	95,445	1,038	65,887	1,248	55,009
September	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58 682
October	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December	5,688	5,720	256,254	2,626	103,697	1,106	71,475	1,299	64,021
1949:									
January	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190
April	5 012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084
August	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843
September	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117
October	5,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673
November	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112
December	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60.193
1950:									
January	4,922	5,483	246,610	2.575	125,298	1,048	63,932	1,209	55,808
February	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828
March	4,878	5,336	241,098	2,539	133,766	938	37,777	1,154	41,860
April	5,006	5,231	244,418	2,518	128,480	969	36,798	1,081	39,189
May	5,118	5,504	239,659	2,648	121,801	1,022	41,659	1,065	39,128
May, 1950 Change:									
In Month	+112	+273	—4,759	+130	—6,679	+53	+4,861	—16	—61
In Year	+146	+309	—34,253	+63	+801	+209	—15,783	—73	—24,448
Week Ended:									
June 17 1950	5,347	5,565	239,862	2,719	116,374	1,009	48,039	1,067	40,740
June 18, 1949	4,922	5,171	274,956	2,571	116,403	746	61,445	1,099	65,594

Monthly News Analysis

Industry Outlook Favorable; Earnings Show Improvement

For the petroleum industry, as for business in general, the latter half of 1950 promises to be better than the first half. This will be an extension of the improvement that began developing in the second quarter, oil companies having shown better earnings in the June quarter than in the first three months.

Commenting on the current outlook at the company's annual stockholders' meeting, Eugene Holman, president of Standard Oil Company (N. J.) said the general trend of all business activity was better than a year ago. He expressed the expectation that the encouraging upward movement that seems to have started would continue at least until the end of the year. The oil business, he said, has been better this year than in the first five months of 1949.

Domestic production and refinery runs by the domestic industry may be as much as 400,000 or 500,000 barrels a day higher by the end of this year than at the end of 1949, Holman said. He based this estimate on trends of demand for petroleum, business in general, and normal weather, emphasizing that weather is an important factor in oil consumption.

For the whole year 1950, Holman estimated that total domestic demand would average between 6 and 8 percent more than last year. Home building is 60 percent above last year, he said, and oil burner sales are 15 percent higher.

Gasoline demand has been strong, Holman pointed out. Colder than normal weather in March and April caused heating oil demand to be 35 percent greater than in the similar period last year, he stated. The weather and a shortage of coal were given as reasons for increased demand for residual fuel. Total domestic petroleum demand for the first four months of 1950 was about 11 percent greater than during the corresponding months of 1949, Holman said.

Probably in line with the trend of results for some other oil companies, Jersey Standard was expected by Holman to show earnings of about $145 million for the first half of 1950, compared with $137,100,000 reported for the first half of 1949. The company earned approximately $65 million in the first quarter of 1950, compared with $75 million for the initial quarter of 1949. The expected better first half for 1950 compared with 1949 would reflect a substantially better second quarter in 1950 ($80 million against $62 in 1949), as the initial quarter was not as good ($65 million in 1950 against $75 million in 1949). In 1950 there is progressive improvement, whereas in 1949 there was progressive contraction of earnings.

Carl H. Pforzheimer & Company, New York stock brokers, recently published a tabulation of oil company earnings and reported that earnings of the numerous companies listed showed an average decline of 12 percent for the first quarter of 1950 as compared with the initial quarter of 1949. Although domestic petroleum demand in the first three months of this year was 10.8 percent higher than a year ago, the report stated, average product prices were about 9 percent lower. Crude production during the first quarter this year averaged 7.6 percent below the same period of 1949, it was added, and this together with reduced product realization produced the drop in earnings.

Total petroleum demand exceeded new supply by 580,000 barrels per day during the first quarter of 1950, according to the Pforzheimer report, and crude and product inventories were reduced to minimum efficient operating levels. Continuance of the favorable trend of demand, increasing crude production, and recovery of product prices were cited as factors indicating improvement in oil company earnings during the second quarter of 1950.

All Large U. S. Cities Due To Get Natural Gas by 1954

Every large city in the U. S. probably will have natural gas available by 1954, according to a new study prepared by the Gas Appliance Manufacturers Association, New York. In reviewing the rapid expansion of the natural gas program throughout the country, H. Leigh Whitelaw, the association's managing director, reports that from July, 1945, to January 1, 1950, the Federal Power Commission had authorized construction of 26,513 miles of natural gas pipe lines costing $1682 million. The chief impact of this program, he says, will be along the Eastern Seaboard and every major city from Maine to Florida eventually will receive natural gas.

The report shows that during 1949 the FPC authorized construction of natural gas facilities stufficient to increase the delivered capacity of the nation's pipe line system by 3 billion cubic feet per day. Authorizations during the all-time peak year involved expenditures of $600 million, and include 7537 miles of new pipe line which will bring new gas or augment present supply to more than 100 cities of 50,000 or more population.

Authorizations pending by the FPC February 1, 1950, provided for an aggregate increase of 4.7 billion cubic feet of natural gas daily.

Natural gas reserves are adequate for the expansion, the report finds. The association reports proved recoverable reserves of natural gas at the peak of 180.4 trillion cubic feet on December 31, 1949, up 5.5 trillion cubic feet from the preceding year.

Oil Industry Is Object of Attacks and Investigations

Demand is growing in Washington for an investigation into all phases of the petroleum industry as groundwork for the development of a national oil policy. Oil is bearing an undue share of the attacks on "big business" and is being pushed into the role of whipping-boy for Administration reform measures and Congressional action.

Senators Homer Ferguson of Michigan and Joseph O'Mahoney of Wyoming have introduced a resolution calling for a $50,000 legislative investigation of advancing gasoline prices. The inquiry would be committed to the Senate Judiciary Committee. Ferguson suggested that the industry was guilty of collusive practices in a series of 10 separate gasoline price rises in the Detroit area during the last 4 years.

Representative Cannon of Missouri, chairman of the powerful House Appropriations Committee, has introduced a resolution asking for a grant of $250,000 for the Federal Trade Commission to probe at least 4 phases of oil industry activity:

- **"Monopolization" of Crude Oil.** Cannon says it is reported that "a chain of a few great aggregations control more than three-fourths of all the oil facilities of the United States."
- **The Interstate Oil Compact Commission.** Cannon wants the FTC to determine if the Compact Commission goes beyond its rightful function of conservation and serves to control the supply and price of oil to the consumer.
- **Depletion Allowance.** Is the depletion allowance, Cannon asks, "an undue en-

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hancement of price to the consumer?"

● **Ownership of Foreign Oil Fields.** Here Cannon would have the FTC look into the problem of imports as well as the conduct of foreign business by the companies.

The Cannon Resolution met hostile reception at the hands of the House Interstate and Foreign Commerce Committee to which it was sent. Oren Harris, chairman of the committee's submittee to which it was sent. Oren Harthat the Interstate Commerce Committee itself might be the body which would conduct the over-all inquiry into petroleum.

Attorney General J. Howard McGrath said in Los Angeles that the government would press divorcement proceedings against the oil industry in many sections of the country. Apparently the Justice Department will urge full separation of all marketing activities of the companies from other functions.

Interior Secretary Chapman has suggested that "the multiplicity of overlapping investigations be eliminated if possible." He said that the oil study now being made by the Harris Committee might be broadened to an over-all position. Chapman earlier this year proposed the plan of a commission to study all forms of energy and make recommendations for conservation and the efficient use of fuels. He has been holding up creation of an agency for this purpose to see if Congress will unify its own separate investigations.

The industry generally is fearful that a "master" investigation of petroleum would end with the endorsement of some kind of government control.

Active Interest Is Shown in Oil Possibilities of Nevada

Quiet but steadily mounting interest currently is being shown in the productive possibilities of Nevada. Nearly a dozen companies, major and independent, have acquired substantial lease interests in at least 7 counties in the eastern half of the state. According to recent reports, about 1600 leases already have been filed, covering a total of nearly 1¼ million acres of land.

Numerous structures have been mapped and seepages are known to exist in some areas. Geophysical crews and geologists have been active in the region for some time. Those familiar with the geology of the area say that production, if it exists, should be found in Pennsylvanian, Mississippian and lower beds at depths ranging from 4000 to 14,000 feet.

Currently, the focal point of interest centers on a wildcat being drilled jointly by Continental Oil Company and Standard Oil Company of California. This well, Meridian Unit 1, is in the Pancake Range about 45 miles west of Ely, in White Pine County. The well was spudded in May 28 and at the middle of June was drilling below 500 feet after setting 13⅜-inch surface pipe at 466 feet.

Industry Profits Help Provide Nation's High Living Standard

Adequate profits, fair return to stockholders, and existence of companies of strong financial conditions are necessary to the best interests of the American people. These things are needed to assure research and improved and efficient plant facilities that make oil increasingly useful and plentiful and raise living standards in the U. S. These facts were pointed out recently by W. M. Holaday, research director for Socony-Vacuum Oil Company, before the American Institute of Chemists at New York.

The petroleum industry is spending $100 million at present and utilizing 15,000 persons in a research program which includes gasoline improvement, more efficient production, refining, and handling of oils, development of new products, and conservation and maximum utilization of oil supplies. In comparison with 1930 efficiencies of utilization, said Holaday, the petroleum industry currently is making a saving of 1 million barrels per day of gasoline, equivalent to 2 million barrels per day of crude oil.

Research creates new jobs and new or larger industries, he stated, and continuing technological advancement are improving standards of living, despite increases in the age of the nation's population and the ratio of non-productive jobs among those employed.

Technologic support requires, however, an economic and political climate favorable to risk capital and business enterprise. As manufacturing units become larger and more costly, they more urgently demand that investment in them be justified. Research effort must be fed from profits of a competitive industry, operating with minimum of regulation and a fair tax structure for maximum encouragement of enterprise.

CORRECTION

Several errors appeared in the listing of Gulf Coast fields in the June, 1950, issue.

WORLD OIL, realizing that this issue will see considerable reference use, wishes to call attention to the following corrections:

On page 89, the WALKER COUNTY heading should be changed to WALLER COUNTY, and UNNAMED (Distillate) field should follow immediately after KATY, NORTH. WALKER COUNTY should then be inserted just above SAM HOUSTON field.

On page 112, ST. LANDRY PARISH should be inserted between RESERVE and CANKTON (Distillate) fields.

Oil Worker Is Three Times Safer on Job than at Home

Safety is really becoming everybody's business in the oil industry, and the record for safety established by the industry during 1949 is not only gratifying but significant. Besides saving life and limb it should have a substantial effect in reducing premium rates on many operations in the drilling, producing and refining branches which eat heavily into profits and operating costs.

The petroleum industry established an all-time safety record in 1949, according to the API. Best previous safety performance established by the industry was reported in 1939. Adding to the impressiveness of this performance is the fact that 7751 more employes were covered in the 1949 report than in any previous study. In addition, total exposure exceeded 1 billion hours.

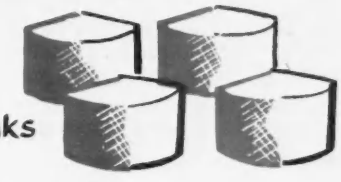
By breaking its previous record the petroleum industry resumed the steady trend toward safer operations which it maintained before the war. During the war years injuries increased disproportionately because of the shortage of skilled workers, increased tempo of operations and a naturally curtailed safety program due to manpower shortage among safety experts.

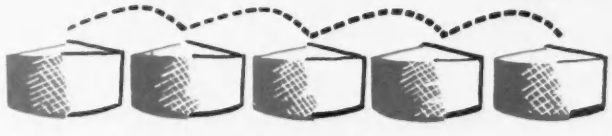
Comparative figures based on the 1949 study show that as a result of the petroleum industry's over-all safety program and employe training, the average employe in the industry is 3 times safer at work than in his own home.

API based its study in 1949 on the experience record of 263 oil companies employing 478,585 persons. The frequency rate of injuries dropped to 10.54 per million man-hours worked and the severity rate of injuries declined to 1.03 days lost per 1000 man-hours worked. This represents an improvement of 14 percent under the 1948 frequency rate and 11.2 percent under the 1948 severity rate.

According to the 1949 study the chances of an employe's being injured fatally now are almost 4400 to 1, against an average of 2800 to 1 in 1946 and the chances for a disabling injury now are 45 to 1 compared with 25 to 1 4 years ago.

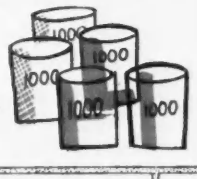
Easy Lesson in CONSERVATION ECONOMICS

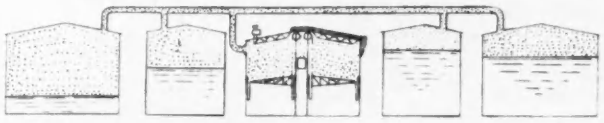
If you have several cone roof tanks 

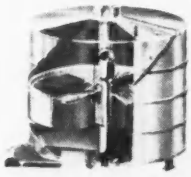
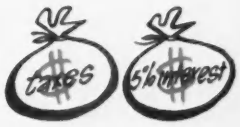
that can be interconnected, 

you can convert breathing losses and filling losses

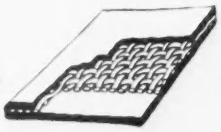
into profits quickly. Field studies at a typical gasoline plant

show $aving$ of more than 5,000 gallons  a week when six cone roof

tanks were hooked up  with a

Wiggins DRY SEAL Gasholder.  Including expenses, 

amortization took less than 20 months. What's more,

the Wiggins 100% DRY SEAL  cuts out rain

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Role of Imports in Meeting Need for Residual Explained

The oil import problem is not homogeneous, and different kinds of imports have different effects on the national economy, Charles L. Harding, a director of the Socony-Vacuum Oil Company, told the Neely subcommittee of Senate Committee on Labor and Public Welfare at recent hearings in Washington. In one of the most clarifying explanations yet given on the crucial issue of petroleum importation, Harding said he was not justifying his own company's trade since its residual imports were small.

"There are two principal kinds of oil imports," Harding said. "One is crude oil and the other is oil products. In 1949 when total oil imports equalled 642,000 barrels a day, imports of crude oil averaged 425,000 barrels a day while imports of residual oil were 240,000 barrels a day, and other products equalled 13,000 barrels a day.

"With oil producibility in this country estimated at about 1 million barrels a day over the present rate of withdrawals, coal producers would not be benefited in any substantial sense by a reduction in the volume of crude imports since the domestic oil industry would immediately make up the loss of supplies from this source by running more domestic crude oil. The volume of finished products turned out by our domestic refiners in competition with coal would therefore continue relatively unchanged.

"The curtailment of residual imports would not be reflected in any important increase in domestic production of crude oil. Residual oil is the unprofitable end product of the refining process and the refiners' realization thereon is almost always less than the cost of the average barrel of crude from which it is extracted. Reduced imports of residual oil probably would drive the price for this product upward, but it is unlikely that our domestic refineries would run much more domestic crude or produce more residual oil as a result.

"In 1948, to illustrate my point, the price of residual oil was at its highest point, $3.03 a barrel, New York harbor, contrasted with the present price of $2.05 a barrel. Nevertheless, domestic refiners east of the Rockies continued to introduce more efficient refining processes to produce less of this low-valued product, the yield being reduced from 21.4 percent in 1947 to 20.1 percent in 1948. The residual yield dipped again in 1949 to 18.3 percent and in 1950 a further reduction is expected.

"The competition between coal and oil is long standing. Right now the advantage appears to be with oil. There have been reasons other than oil imports which account for this trend. A substantial portion of the oil substituted for coal has consisted of products which are not imported. In 1949, for example, the increased use of diesel engines by our railroads was directly responsible for a 33 million-ton reduction in the consumption of bituminous coal. Anthracite coal, too, has failed to obtain its share of the expanding home-heating market. Among industrial users there has been an important replacement of coal by natural gas.

"The demand for residual oil has increased only slightly during 1949, but the domestic supplies of residual oil were reduced some 130,000 barrels daily (east of the Rockies) from 1948 due to the lower yield and the over-all slowing of refinery operations. During the first 6 months of 1949, under impetus of the lower prices, inventories of residual oil were liquidated at the rate of 55,000 barrels a day. It became necessary, therefore, to obtain supplementary supplies of residual fuel oil in order to meet the demand in the eastern states and prevent inventories from going below workable levels.

"The bulk of the increase in residual oil imports which has occurred in 1949 and 1950 to date has merely offset the loss of residual supplies from domestic refinery production. The accompanying table shows there has been little change in total supplies of residual fuel oil, including imports, which have been developed in 1948-1949 and are anticipated in 1950. (Table 1.)

"The bills which have been introduced into Congress fall into 2 general categories. The first calls for a quota on oil imports which would reduce total imports expected to average 817,000 barrels a day in the first half of 1950 to the very low figure of about 250,000 barrels daily. The second would increase the present tariff on crude and residual oil from 10½ cents a barrel to $1.05 a barrel. This tariff would in all likelihood mean a virtual embargo against both crude and residual oil imports and would be even more restrictive than the proposed quotas."

Testifying before the Neely subcommittee, Assistant Secretary of State Willard L. Thorp said import restrictions would seriously affect American trade relations and might endanger national security.

However, J. Ed Warren, president of Independent Petroleum Association of America, and Fred W. Shield, former president, testified that independent producers had been hurt by oil imports.

TABLE 1—Supplies of Residual Fuel Oil
(Barrels per Day)

YEAR	Total New Supplies	Imports (Included in Total New Supplies)
1948	1,102,000	145,000
1949	1,044,000	204,000
1950 (Forecast)	1,104,000	240,000

Development of Tidelands Unsettled After Decision

The situation with regard to oil development on the Continental Shelf remains highly unsettled, following the ruling of the U. S. Supreme Court, upholding the federal government claim to the submerged lands off the shores of Texas and Louisiana.

Interior Secretary Chapman, after consultation with President Truman, is considering one of two ways to clinch the government's victory in the tidelands case without new legislation. Government officials are moving rapidly to apply federal control to all oil operations in the Gulf of Mexico, and may adopt one of the two following plans:

1. Extend the oil and gas leasing law to the submerged lands by reversing a previous ruling that the law did not so apply.

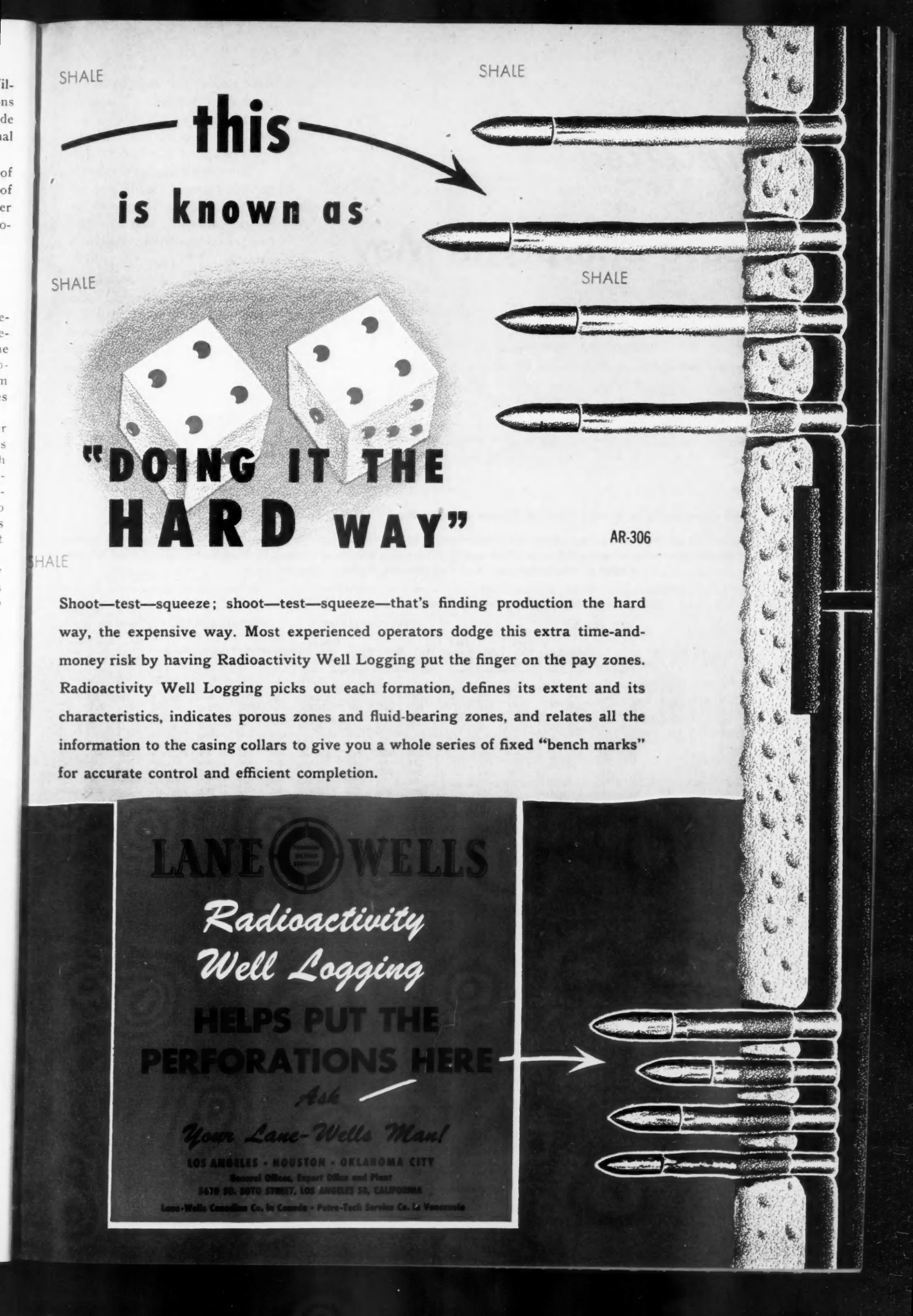
2. Effect agreements with present operators on offshore programs.

Toward the second of these alternatives, notification has been prepared to operators on all leases issued before June 23, 1947, that they can apply to the Interior Department for the right to continue work under certain specified terms and conditions. The date is that of the decision in the California tidelands case. This notification may be held up if officials persuade Chapman to adopt a "tougher" attitude in connection with the government's recently confirmed "inherent rights" to the submerged lands.

There is further report that the military establishment may propose declaration of all Gulf lands as a naval petroleum reserve.

Meanwhile opponents of federal control are preparing another quitclaim bill in the House of Representatives, under the blessing of Speaker Sam Rayburn. However, it is now conceded that even if such a measure could pass the House it could never clear the Truman veto awaiting it.

Senator O'Mahoney (D. Wyo.) is pushing measures to establish federal control solidly over the tidelands. As soon as the Supreme Court upheld the federal government against Texas an Louisiana, O'Mahoney proposed Congressional action to implement the decision.



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Completions

Increase Sharply in May

DRILLING activity increased sharply during May and the resulting large number of well completions boosted the year's total wells into an 8 percent lead over those completed in the first 5 months of 1949. May's wells set a 2-year high for completions in any one month, and were second only to the more active periods of 1948, greatest year in drilling history.

While 3878 wells completed in May were not the largest number in any comparable period, the 14 million feet drilled in those wells did set a monthly record. Total footage drilled in the 16,627 wells completed in the first 5 months of this year amounted to 61,256,107 feet, and while the wells did top last year's total by 8.2 percent, the amount of footage bettered last year's mark by 10.3 percent. So far, new wells drilled in 1950 have been 75 feet deeper on the average than those of a year ago.

At the end of May, active drilling rigs were at the highest level since the beginning of 1949. The month started with 4224 rigs on active locations and by the end of the period these had been joined by 294 others to swell the total to 4518. That was the largest number busy at the end of any month since December, 1948. During May, the drilling rig total gained 101 in Texas alone, with the major part occurring in the western part of the state.

Well Completions in the United States During May, 1950, and Cumulative for Year

(Figures compiled by WORLD OIL staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the *Producers Monthly*)

STATE or DISTRICT	MONTHLY COMPLETIONS, MAY, 1950									TOTAL COMPLETIONS				CUMULATIVE TOTAL				Rigs in Operation (Drilling, Rigging Up and Shut Down)		
	NEW WELLS								Total Drilled Deeper											
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New		May, 1950	April, 1950	May, 1949	Footage May, 1950	Wells 1950	Wells 1949	Percent Diff.	Footage 1950	May 31, 1950	April 30, 1950	May 31, 1949
Alabama	1			4				5		5	2		20,772	15	6	+150.0	54,268	3	4	4
Arizona															3	—100.0		4	4	6
Arkansas	23			14				37		37	28	27	123,481	155	114	+ 36.0	501,979	24	20	35
California	102		2	44				148	9	157	141	220	711,360	754	1,092	— 30.9	3,109,143	223	225	267
Colorado				2				2	1	3	8	11	5,429	18	24	— 25.0	61,022	12	11	18
Florida				1				1		1			3,270	7	8	— 12.5	44,386	1	3	2
Georgia												1		2	4	— 50.0	9,075			1
Idaho											2			3			8,540	3	2	
Illinois	120		1	128				249		249	196	235	550,457	898	857	+ 4.8	1,872,618	249	207	275
Indiana	45		5	80	1			131		131	89	132	230,273	519	434	+ 19.6	911,868	191	180	137
Kansas	201		37	163			6	407	1	408	292	248	1,309,917	1,488	1,102	+ 35.0	4,836,180	351	292	314
Kentucky	42		23	19				84		84	90	72	155,507	369	348	+ 6.0	686,982	108	98	84
Louisiana	117	15	18	55				205	1	206	205	173	1,237,471	969	773	+ 25.4	6,047,877	217	221	236
North Louisiana	55	9	15	28				107		107	103	97	376,845	487	387	+ 25.8	1,786,769	71	57	71
South Louisiana	62	6	3	27				98	1	99	102	76	860,626	482	386	+ 24.9	4,261,108	146	164	165
Maryland														1			3,612	2	1	
Michigan	51		1	40			1	93		93	54	74	200,998	326	369	— 11.7	776,861	140	138	130
Mississippi	7	6		16				29		29	36	30	217,132	153	143	+ 7.0	1,141,724	24	29	26
Missouri			1	2				3		3	5	2	1,995	20	7	+185.7	13,668	7	5	5
Montana	16		1	9				26		26	25	22	50,497	83	88	— 5.7	232,780	29	17	51
Nebraska	2		1	3				6	1	7	5		29,030	28			113,129	3	2	1
Nevada																		1		
New Mexico	32		2	8				42	1	43	53	52	170,963	242	238	+ 1.7	1,102,823	75	68	93
New York	30				20			50		50	41	53	70,302	266	526	— 49.4	374,840	83	76	109
North Dakota																				1
Ohio	35		23	23				81	2	83	68	103	170,058	362	449	— 19.4	784,494	131	138	134
Oklahoma	297		30	185		3	1	516	16	532	425	351	1,821,838	2,157	1,667	+ 29.4	7,419,463	527	540	486
Oregon																		1		
Pennsylvania	48		27	6	42	8		131	2	133	118	130	243,032	608	937	— 35.1	1,111,517	251	203	241
South Dakota														1			5,710	2		2
Tennessee			1	1				2		2		5	2,563	3	14	— 78.6	3,993	9	8	6
Texas	957	17	48	436	1		1	1,460	19	1,479	1,266	1,195	6,307,285	6,691	5,711	+ 17.2	28,242,766	1,502	1,401	1,260
Dist. 1—S. Central	20	1	1	20				42		42	31	45	101,884	185	246	— 24.8	516,724	30	29	43
Dist. 2—Middle Gulf	38	2	9	20				69	2	71	45	54	411,598	247	270	— 8.5	1,426,601	61	59	45
Dist. 3—Upper Gulf	89	3	5	46				143	2	145	133	91	838,185	644	527	+ 22.2	3,687,500	137	140	137
Dist. 4—Lower Gulf-SW	69	4	9	58				140	4	144	136	113	704,456	668	623	+ 7.2	3,160,032	130	122	106
Dist. 5—E. Central	15			8				23		23	13	15	92,605	75	106	— 29.2	326,088	23	27	16
Dist. 6—Northeast	66	7	3	9				85		85	17	100	404,915	266	403	— 34.0	1,260,697	33	33	42
Dist. 7-B—N. Central	70		5	81	1			157	2	159	152	165	341,594	766	775	— 1.2	2,191,151	132	142	159
Dist. 7-C—W. Central	35		6	12				53	3	56	59	65	233,711	332	176	+ 88.6	1,382,479	85	78	57
Dist. 8—West	331			45				376	3	379	335	272	2,116,904	1,674	1,135	+ 47.5	9,022,696	532	470	393
Dist. 9—North	169		2	132			1	304	3	307	256	171	858,133	1,428	960	+ 48.8	3,995,462	224	200	135
Dist. 10—Panhandle	55		8	5				68		68	89	104	203,300	406	490	— 17.1	1,273,336	115	101	127
Utah	1							1		1	1	6	4,260	8	17	— 52.9	27,572	7	8	18
Virginia																		1	1	
Washington											1			2			16,032			
West Virginia	12		39	12				63	3	66	32	33	170,102	258	187	+ 38.0	633,107	284	275	240
Wyoming	36		2	12				50		50	40	40	256,397	221	247	— 10.5	1,108,078	53	47	94
Total U. S.	2,175	38	262	1,263	64	11	9	3,822	56	3,878	3,223	3,215	14,064,389	16,627	15,365	+ 8.2	61,256,107	4,518	4,224	4,276

Looking Ahead

SLOWING DOWN OF OIL FINDING IN U. S. is forecast by decline in geophysical activity. Oil and gas discoveries are based to great extent on work of geophysical crews, and the number of crews in operation has declined drastically in recent months. R. L. Foree, president of Texas Independent Producers and Royalty Owners Association, said average was 532 in 1948, 479 in 1949, only 394 in first quarter of 1950, and the number continues to decline. Foree blamed excessive imports, which he said were making exploration in U. S. unprofitable.

EXTENSION OF INTERSTATE OIL COMPACT for an additional period of 4 years was unanimously endorsed June 20 at a conference of governors of member states of the Compact Commission, other oil and gas producing states, and prospective producing states, during the National Governors' Conference. The compact will expire September 1, 1951, unless renewed by Congress. A resolution was adopted that the Interstate Oil Compact Commission should not only invite all nonmember oil and gas producing states to join the Compact but should be active in securing their membership.

RAILROADERS CONTINUE TO SWITCH from steam to diesel, and transportation heads predict that by 1960 a steam locomotive will be a curiosity. The trend is noted in a recent Missouri-Kansas-Texas Railroad report, which revealed the line had accepted 18 diesels in 1949, which replaced 52 steam locomotives, while an additional 54 steam engines were scrapped. Greater efficiencies in both passenger and freight service are credited to diesel power.

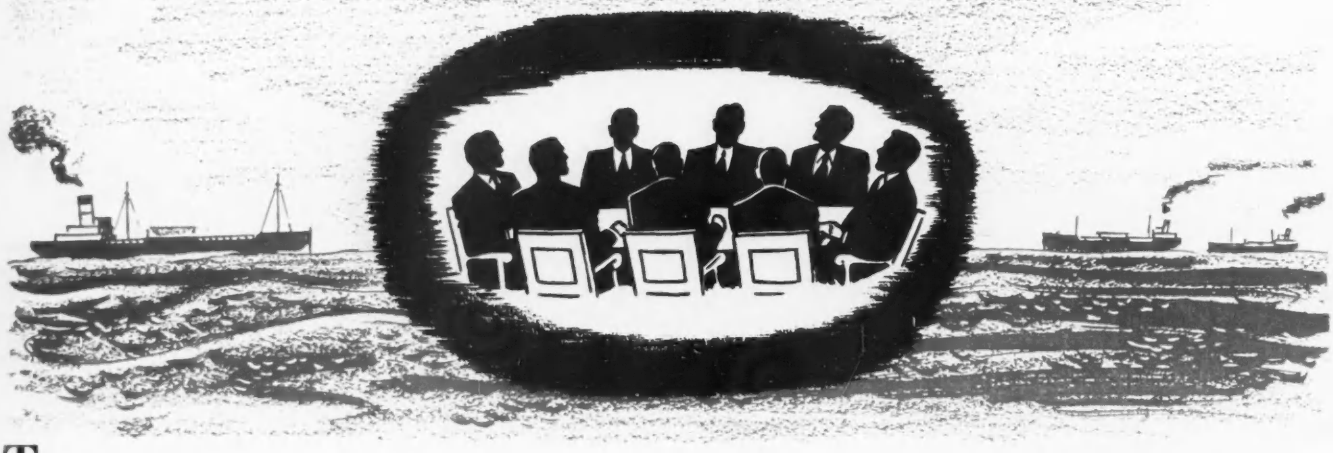
A SOLID FIREPROOF ADSORBENT, a fullers' earth material, has been developed as an above-ground container for storage of natural gas liquids and LPG products. In recent pilot plant test, natural gas was compressed, cooled, and pretreated by adsorbents for removal of moisture, gasoline and liquefied petroleum gas components. Resulting liquid was then flashed to a low pressure for further cooling, after which it was put in storage container. Pilot plant capacity attained 600 cubic feet of gas in 2 cubic feet of "Methanite." Advantages: greater safety in handling products in concentrated areas and in transporting by ocean vessel and river barges.

BETTER, MORE POWERFUL gasoline is predicted for the motorist by 1960 as a direct outcome of the oil industry's current research program. It is estimated the industry is currently spending $100 million and employs 15,000 persons in its over-all research which has been progressing for the past 20 years. By 1960 quality gasoline will average about 95-97 research octane number.

PETROLEUM INDUSTRY SCIENTISTS are experimenting on raising soil temperatures with carbon black, a product of natural gas. They hope to help farmers combat hazards of late freezes in spring and early freezes in fall. In preliminary tests, 2 tons of carbon black per acre were mixed into the top 2-inch layer of sandy loam, and surface and near-surface temperatures were recorded every 15 minutes for a year. Carbon black treated soil absorbed more of sun's heat and maintained somewhat higher temperature than untreated soil.

Compromise on Imports Essential

By L. J. LOGAN
Associate Editor



THE oil imports question has become so controversial and apparently so serious that some definite and prompt action toward at least a partial settlement of it is highly essential for everybody concerned.

So much has been said about the problem that it takes a great deal of sifting and probing of significant facts to arrive at any clear ideas of what should be done and what can be done.

However, by sticking to fundamental facts and statistics, it is not hopeless to try to determine roughly what would be reasonable imports and how they could be assured.

It is here suggested that a reasonable objective is a total U. S. oil import volume of 10 percent of U. S. crude runs to stills, which would amount to 550,000 barrels per day in 1950, and more or less thereafter, depending on refinery runs.

It is further suggested that the first practical step toward this objective might be to seek a restoration of the tariff rates originally set by Congress in 1932 but subsequently cut in half by the executive department under reciprocal trade agreements, which Congress authorized.

Even at the original 1932 rates, the tariffs really would be less than one-half as high as originally, in relation to prices of oil, because of subsequent inflation and more than doubling of the price of crude. If the 1932 rates would not satisfactorily keep imports within reasonable bounds, it might be logically contended that the rates should be doubled, or put at 20 percent of market value of the oil involved, as originally, to compensate for inflation.

These conclusions and suggestions are based on a study of statistics on imports and numerous statements and ideas on the subject from many sources.

As to how much foreign oil should be imported into the U. S., current arguments range from complete barring of imports (the Gossett bill would impose a tariff of $1.05 per barrel and represent a virtual embargo) to importers' defense of the rate of 800,000 barrels per day actually imported in the first quarter of 1950. Some possible compromises or apparently "reasonable" middle-ground figures may be offered as follows:

- **Average between above extremes:** 400,000 barrels daily. This is about same as average for 1946-1947.
- **Balancing imports with exports** would cut imports down to the 264,000 barrels a day exported in first quarter of 1950. This would be more than imports in any year 1931 through 1944, inclusive.
- **Limiting imports to 5 percent of domestic demand.** Several bills would do this, based on prewar (1935-1939) ratio of imports to domestic demand. This would allow imports of about 300,000 barrels daily.
- **Limiting imports to 7 percent of domestic demand.** This has been suggested, based on ratio of imports to domestic demand in the 25 years, 1925-1949. It would result in imports currently of about 450,000 barrels daily, based on current domestic demand.
- **Basing imports on 1948 experience.** This has been proposed because 1948 was a year of threatened oil shortages, when imports performed a desirable function of supplementing domestic supply, without going so high as to cause over-supply or demand for import curbs. In 1948, imports represented 8 percent of total supply. If 8 percent of the estimated total required supply in 1950 were supplied by imports, the imports would average about 512,000 barrels per day. (In 1948, imports averaged 514,000 daily and exports 368,000 daily; in the first quarter of 1950, imports were 800,000 daily and exports 264,000 per day. In 1948, the U. S. was a net importer of 146,000 daily. If the U. S. in 1950 were a net importer in the same amount of 146,000 daily, imports would be 410,000 barrels per day.) These data indicate that if 1948 experience is a good criterion, imports might be 512,000 daily, disregarding export level, or 410,000

TO SETTLE on a reasonable and practical basis the controversy over U. S. oil imports, a compromise of some kind is necessary, since the views of importers and the critics of imports are so widely apart.

Solution of the problem requires answers to these two simple basic questions: (1) How much foreign oil should be imported? (2) How should achievement of the desired import level be attempted?

As a basis for compromise on the volume of imports, it is here suggested, in view of pertinent facts and statistics, that total petroleum imports might reasonably average 10 percent of crude runs to stills at U. S. refineries. This would be equivalent to about 550,000 barrels per day this year, compared with 800,000 daily actually imported in the first quarter.

As regards the method of achieving a desirable level of imports, the opinion is here offered that the most practical and workable means is through revision of tariff rates, rather than through attempted voluntary action of importers or imposition of quotas or allocations by government. Raising oil tariffs above present rates would be reasonable, to compensate for inflation of crude prices in recent years.

daily, considering shrinkage of needs for export market.

Note on 1948 Imports. By Grades of Oil. Since the 1948 experience is especially interesting, some data will be here given on how much of imported oil was crude, residual fuel oil, etc., and how those figures compare with current imports. In 1948 as now, imports were mostly heavy crude with high residual fuel yield and residual fuel oil as such, as shown in the accompanying table (Table 1).

It has been suggested that imports of 1948 represented U. S. needs for foreign oils under conditions of limited availability of domestic oils; that domestic producing and refining ability subsequently have been increased to exceed demand by at least 1 million barrels daily; and that any imports above 1948 would now be supplanting domestic production.

Modification of 1948 Record To Recognize Increased Residual Demand. While the 1948 record appears to be a reasonable general guide, it may be contended that residual imports should be above 1948, though under 1950 rates, as demand is estimated at 1,449,000 daily in 1950, against 1,402,000 daily rates, in 1948, an increase of 47,000 barrels daily; while furthermore, residual yield at U. S. refineries is down to 22 percent in 1950 from 23 percent in 1948, requiring more residual imports to supplement domestic oil.

Based on experience for the past 15 years and also in 1949 and 1950, it is estimated that residual yield from crude at U. S. refineries in 1950 should be about 22 percent, as it actually was in the first quarter. The Bureau of Mines' recently revised forecast for 1950 shows U. S. refinery runs of 5,514,000 barrels per day required in 1950. From these runs, a 22 percent yield of residual would provide 1,213,000 barrels per day of domestic residual production. Based on 1949 experience, 13,000 barrels a day would be provided by transfers of crude to residual fuel supply. Thus 1,226,000 barrels (refinery output and transfers) would be provided. This would be short of the Bureau of Mines' revised estimate of residual demand of 1,449,000 barrels daily by 223,000 barrels daily, the indicated deficiency to be supplied by imports to supplement domestic supply. (With residual yield less than 22 percent, more imports would be needed; with yield higher, less imports.

If this indicated present demand for residual imports of 223,000 barrels per day is substituted for the actual imports of 145,000 daily in the 1948 data of Table 1, without changing other import data, then the 1948 imports on revised basis would include 353,000 barrels per day of crude, 239,000 a day of refined products, including the 223,000 of residual, or a total of 592,000 barrels per day of total imports. This would be 200,000 a day or 25 percent less than current imports.

U. S.-Mexico Agreement to End

After this article had been made ready for publication, it was announced in Washington on June 23 that the U. S. and Mexico would terminate their reciprocal trade agreement as of December 31, 1950. This action is a step toward solving the U. S. oil import problem. It will result in doubling present tariffs on substantial volumes of the foreign oils being brought into the U. S. The cancellation resulted from difficulties over tariffs on farm crops, visa troubles, and labor complications.

Following termination of the Mexican agreement (of 1943), U. S. tariffs on oil and other items involved will revert on January 1, 1951, to rates provided for in the Venezuelan agreement of 1939. Under that pact, crude oil, gas oil, and fuel oil will be taxed at 10½ cents a barrel, or one-half the regular rate of 21 cents, but only to the extent of 5 percent of the quantity processed in U. S. refineries in the preceding year. All imports in excess of that quota will take the full rate of 21 cents a barrel. The amount taking the lower rate will be divided among oil-exporting foreign countries on a quota basis—not only Venezuela but also all other foreign source countries participating.

Under the Venezuelan agreement, if it is kept in effect, only about 275,000 barrels per day of oil imports will be admitted in 1951 at the special tariff rate of 10½ cents a barrel. This is 5 percent of the Bureau of Mines estimate of 5,514,000 barrels per day of crude to be run to stills in 1950. If imports should continue at the present rate of about 800,000 barrels per day, then 525,000 daily would be in excess of the volume accorded the special tariff rates and would be taxed at the full rate of 21 cents a barrel.

However, some reduction of crude imports in 1950 from the 1948 rate may be argued as being necessary to compensate for somewhat lower U. S. crude runs to stills estimated for 1950. Refinery runs averaged 5,548,000 barrels per day in 1948 but the Bureau of Mines' recently revised estimate indicated the need for U. S. crude runs to stills averaging only 5,514,000 daily in 1950. This would be 34,000 barrels a day less than in 1948. In view of the present ample domestic crude supply, it may be contended that this 34,000 barrels per day reduction of volume of crude runs to stills as compared with 1948, lowering crude needs by that amount, should come off 1948 crude imports data, cutting them to 319,000 a day.

With residual imports of 223,000 daily and crude imports of 319,000 daily, as justified above, and leaving all other imports at 16,000 daily as in 1948, currently justified total imports would be 558,000 daily. This would be equivalent to 10 percent of this year's U. S. crude runs to stills.

Imports of 10 Percent of Refinery Runs or 550,000 Barrels Daily in 1950 Suggested as Compromise Goal. Among the numerous mentioned levels of imports, advocated and actual, that of 10 percent of U. S. crude runs to stills, equivalent to 550,000 barrels per day for 1950, emerges as an apparently reasonable tentative basis for compromise. It is supported in data above by important statistics and facts. In further support, it may be said that it is about the average between the rate of 264,000 barrels daily which independents may persuasively ask to exactly balance imports with exports and the 800,000 barrels a day of current actual imports that most of the importers stoutly defend as not excessive.

Independent oil producers, coal companies and coal miners, and railroads and railway workers may say that this suggested compromise figure is too high and base their objection on the necessity of minimum oil imports to guarantee healthy domestic coal, railroad, and oil industries, in the interest of national welfare and security. But importers may argue the figure is too low and base their contention on the necessity of substantial imports to conserve domestic reserves to assure strategically located foreign reserves for American availability in war or emergency, to assure American consumers of ample supplies and reasonable prices of residual oil and other fuels, and to foster U. S. world trade in the interest of this nation and the nations traded with. These arguments that the compromise figure is too high or too low tend to cancel each other out.

If imports were reduced by 250,000 barrels a day, from 800,000 to 550,000 barrels, and domestic crude production were increased by the same amount, on equitable basis among the states, perhaps 100,000 barrels a day or more would go to Texas, and substantial amounts to Louisi-

TABLE 1
U. S. Oil Imports in 1948 and First Quarter of 1950

PRODUCT	Barrels Daily in 1948	Barrels Daily in 1st. Qtr., 1950	Change from 1948
Crude Oil	353,000	456,000	+103,000
Refined Products	161,000	344,000	+183,000
Residual Fuel Oil	145,000	319,000	+174,000
Distillate Fuel Oil	7,000	2,000	— 5,000
Kerosine	.....	3,000	+ 3,000
Gasoline	1,000	.....	— 1,000
Other Refined Oils	8,000	20,000	+ 12,000
Total Imports	514,000	800,000	+286,000

ana, Mississippi, and other states, with fields yielding heavy crude benefiting particularly. Prices of heavy crude and residual fuel oil declined sharply after 1948 and have shown little recovery, and besides affecting producers, the market decline made refining unprofitable for many plants. The possibility that residual prices are unjustifiably low is suggested by the relative ease with which fuel oil has been making inroads into former coal markets. With imports lower, some improvement of fuel oil prices might be necessary to bring out needed domestic supply and cover transportation costs, and domestic producers and refiners might benefit to some extent. But any improvement in prices would be limited by increased competition of coal for the fuel market, and insofar as coal became more competitive, the coal and railroad industries and workers would have less ground for complaint about loss of markets to oil.

Means of Limiting Imports. Even if there could be general agreement on a compromise rate of imports, the means for reaching the goal would be a difficult problem. Decision on the method also might require compromise.

For guaranteeing reasonable imports, three solutions have ben proposed:

1. Voluntary action of importers.
2. Revision of tariffs.
3. Inauguration of quotas, administered by the government.

Of the three methods, No. 2 represents probably the most practical answer. Voluntary action by importers would raise the question of the legal right of companies to enter any such agreements or understandings; and with each company acting independently, sacrifices made by one could be cancelled by action of another. Use of quotas, made official by government, might be practical as regards the total for all importers, but it would be difficult to equitably initiate and maintain allocations as between importing companies. Furthermore, such government-bureau regulation of imports would be a step toward similar regulation of domestic production, representing a grave threat to the continuance of the petroleum industry as a private enterprise.

Tariffs Now Half of 1932 Rates. The solution seems to narrow down, as a practical matter, to revising tariffs in such manner as to try to make them result in the desired volume of imports. Excessive import duties would shut out imports altogether and are not justified. (Importers assert that the Gossett Bill to impose a tariff of 2½ cents a gallon or $1.05 a barrel would be a virtual embargo.) On the other hand, tariffs as they stand today are letting in foreign oils in volumes widely denounced as excessive. As prescribed by Congress in 1932, the tariff on crude oil, fuel oil, and kerosine is ½ cent a gallon or 21 cents a barrel; on gasoline 2½ cents a gallon, and on lubricating oil 4 cents a gallon. But under trade agreements made by the executive department of the government, in consideration of lowering of tariffs on foreign imports of American goods, the U. S. tariffs on imports of various foreign goods, including oils, have been reduced. In the reciprocal trade agreements program, petroleum excise taxes have been affected on three occasions: in the agreement with Venezuela in 1939, with Mexico in 1943, and in the multilateral agreement at Geneva in 1947.

The present status of the oil import taxes is that rates provided by Congress in 1932 have all been cut in half, being now ¼ cent a gallon or 10½ cents a barrel for crude oil, fuel oil, and kerosine; 1¼ cents a gallon or 52½ cents a barrel on gasoline; and 2 cents a gallon or 84 cents a barrel on lubricating oil. Through the action of the executive branch of the federal government, the Congressional policy regarding oil imports has been halfway invalidated. Under the Venezuelan agreement, the 50 percent reduction of tariffs applied only to crude oil, gas oil, and fuel oil; and was applicable only on a quota basis on 5 percent of the total quantity processed in U. S. refineries; all imports in excess of that quota having been subject to the full tax. Under the Mexican agreement, quota restrictions were removed, and tariff reductions were extended to kerosine, liquid asphalt, and road oil; while under the Geneva agreement reductions were applied also to gasoline, lubricating oil, and any other products.

Agreements Have "Escape Clauses." Under "escape clauses" of the agreements, either country involved can suspend, withdraw, or modify the trade concessions for various reasons, including violation of the agreement by the other country or increase of imports to the point of causing or threatening serious injury to domestic producers.

Since the U. S. and Mexico have mutually agreed to cancel their agreement at the end of 1950, oil imports might be put back on the basis of the Venezuelan agreement, calling for only a quota of 5 percent of U. S. refinery runs to take the reduced tariffs and for these rates to apply only to crude oil, gas oil and fuel oil.

Furthermore, even the Venezuelan agreement concessions could be withdrawn on the basis of "causing or threatening serious injury to domestic producers."

The U. S. Department of State administers the trade agreements program, which was authorized by Congress, and could through the "escape clauses" either (1) restore the 1932 tariffs on all imports above 5 percent of domestic refinery runs, or (2) restore the 1932 tariffs on all imports. The latter action would double all present import duties. It should go part of the way toward settling the import problem.

Beyond voiding by the executive department of tariff cuts in trade agreements, any increase in oil tariffs would have to be enacted by Congress.

State Department or Congress Could Change Tariff Rates. When a problem has to be solved through government intervention, the mills grind slowly, compromise is necessary, and the objective may have to be reached in stages. It was not too difficult to abrogate the Mexican agreement, as it was reported to be unsatisfactory to Mexico as well as the U. S. Getting back to the Venezuelan agreement basis should have some deterring effect on imports, but this effect would be limited and would involve the difficult problem of setting up quotas by countries for sharing in the 5 percent of U. S. refinery runs coming in at the 50 percent of 1932 tariff rates; with the Middle East now a more important source than formerly and entitled to higher quota than previously.

Under present conditions, it would be desirable, when the Mexican agreement is abandoned, to also at the same time withdraw from the Venezuelan agreement, fully restoring the 1932 tariff rates originally set up by Congress. This would be justified to a large extent simply on the grounds that even the original tariffs really are only about one-half as effective as when originally applied because of World War II inflation and more than doubling of the price of crude. Before the war, the price of crude in the U. S. averaged only a little over $1 per barrel, and the original tariff of 21 cents a barrel was equivalent to a 20 percent rate. Now the U. S. crude price is a little more than $2.50 per barrel, and if the tariff now were 20 percent, it would amount to 50 cents a barrel. If the original tariff of 21 cents a barrel on crude and fuel oils were restored, it would be in effect still a form of a "trade agreement," allowing oil imports at less than 50 percent of inflation-adjusted "normal" rates. This adjustment would appear quite reasonable and fair to every element concerned, including the foreign countries.

As a matter of fact, because of inflation, there is some question if even the original 1932 oil tariff rates would be effective in holding down imports to the point of ending controversy. If imports continued controversially high, independents could with logic urge upon Congress a revision of the tariff rates on crude and fuel oils to put them back in former ratio to the buying or selling price of crude. If Congress were to put the tariff on the basis of 20 percent of value, as formerly, the duty would be as much as 50 cents a barrel. If the 1932 rates were simply doubled, the increase for crude and fuel oils would be from ½ to 1 cent a gallon, or from 21 to 42 cents a barrel.

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HINES H. BAKER

Let the People

Tidelands

EDITOR'S NOTE: *In this article, the second of a series of interviews with leading oil men, the pressing question of tidelands ownership is discussed by Hines H. Baker, president of Humble Oil & Refining Company. Baker calls upon his more than 30 years' experience as an attorney and oil man in this analysis of the Supreme Court's recent decision and its possible far-reaching effects on states' ownership of natural resources.*

Q. *What did the Supreme Court decide in the Texas and Louisiana tidelands cases?*

A. The Court decided that the two states did not own the areas off their shores within their declared boundaries. It did not hold that the federal government owned these areas but held that it had paramount rights in and dominion over them, including their resources.

Q. *How will the decisions affect the Texas free-school fund and the economy of the state of Louisiana?*

A. If permitted to become effective, the decision in the *Texas* case will be a serious blow to the school fund, since revenues from offshore lands many years ago were dedicated to this fund; and the decision in the *Louisiana* case will be a blow to that state where such revenues go to reduce the public debt.

Since 1945, Texas and Louisiana have received more than $46 million in bonuses and rentals on oil leases on offshore areas and had good reason for expecting even larger sums in the future. These revenues, and the royalties derived from oil and gas production, will be cut off unless Congressional action is taken to restore them.

Q. *Upon what theory did the Court reach its conclusions?*

A. The Court said that the United States had paramount rights in and dominion over offshore resources because it might need these resources to conduct foreign relations, wage war, and regulate foreign commerce. It advanced the novel doctrine that since the United States exercises the governmental functions of waging war, conducting foreign relations and regulating foreign commerce, property rights in the marginal sea "must then be so subordinated to political rights as in substance to coalesce and unite in the national sovereign." In the *Texas* case, the Court held that Texas owned its tideland areas while a republic but gave them up upon entering the Union in 1845 so as to be on equal footing with other states. Two fallacies in the Court's reasoning on this point are: (1) it disregards the Annexation Agreement between Texas and the U. S. reserving the tidelands to Texas when it became a state, and (2) it overlooks the fact that the Agreement does not provide that Texas shall be on an equal footing with other states.

Q. *Under the basic theory of the opinions is there danger of confiscation and nationalization of all natural resources?*

A. There is definitely such a danger. As has been said, the Court adopted a theory under which, because of national responsibility with respect to war, foreign relations and foreign commerce, the U. S. was deemed to have rights in the marginal sea transcending those of a property owner. Until the tidelands decisions were handed down, it had never been supposed that the exercise of delegated national authority in these

Know:

Decision Imperils States Rights

An interview with

HINES H. BAKER

President, Humble Oil & Refining Company

fields could wipe out property rights of the states and by some unknown alchemy coalesce them into federal governmental powers. Obviously the same theory can be applied to allow the federal government to seize other state lands and private property for, as pointed out in Mr. Justice Reed's dissenting opinion in the *Texas* case. "National responsibility is no greater in respect to the marginal sea than it is toward every other particle of American territory." The great danger in the decisions, therefore, is that the theory advanced in them might be utilized to nationalize all state properties, all natural resource industries, and even all private property, and thus destroy free enterprise and usher in state socialism.

Q. *What problems confront offshore operators in regard to existing operations and the payment of rentals and royalties?*

A. Offshore operators are confronted with a number of problems. Uncertainties exist as to whether their leases are in effect, whether the heavy rentals and royalties can with safety be paid the states, and if so paid will continue the leases in effect. Also, operators are confronted with the risks incident to carrying on highly expensive drilling and production operations under the state leases.

These uncertainties make it necessary that Congress pass permanent legislation dealing with the whole subject of control and development of offshore areas. In view of the shortness of time, however, it may be impossible for Congress to act on all these matters at this session. Thus, as a temporary expedient, Congress might find it necessary to pass interim legislation to carry out the assurances previously given by the President and the Attorney General that the equities of the states and the property rights acquired by operators in good faith will be respected. Such legislation would, no doubt, authorize continuation of operations in accordance with the terms of leases issued by the states.

Q. *How do hazards and costs of operations and the royalty obligations under off-shore leases compare with those on uplands?*

A. In general the leases granted by the states carry the same royalty provisions as are contained in leases on uplands. This is true notwithstanding the fact that the hazards of operations offshore are much greater and the costs from three to five times as high as on uplands. Even those operators who have succeeded in finding oil fields offshore will not know for some time whether the capital they have risked will ever be returned. Offshore operators have spent about $230 million for bonuses and rentals, in exploring for oil and gas, in drilling dry holes, and in drilling and operating producing wells on the continental shelf off the Gulf Coast. Only a small part of that amount has been returned from production up to this time.

Q. *Will the decisions slow down exploration and development work and drilling in the Gulf?*

A. During 1949 and 1950, operations in the Gulf have been reduced considerably because of the uncertainty brought about by the filing of the *Texas* and *Louisiana* cases. The decisions will cause operations to be even more drastically reduced. Geophysical exploration has already come to a standstill.

Q. *What type of legislation would offer a satisfactory solution of the tidelands problem?*

A. The Walter Bill, now pending in the House, is a measure which would seem to resolve satisfactorily the conflicting interests of all concerned. It would release to the states the offshore areas within their traditional boundaries (thereby confirming ownerships which were established over a period of about 150 years), provide a federal leasing policy for areas outside traditional state boundaries, confirm leases heretofore acquired from the states, and allow the states to extend their boundaries to the outer edge of the continental shelf for the purpose of applying their conservation regulations to oil and gas operations. This bill is supported in principle by the Governors' Conference, the American Bar Association, and other civic and patriotic organizations, and has the active and vigorous support of the National Association of Attorneys General.

A year ago Speaker Rayburn undertook to work out with the states and the Federal Government a draft of bill (later introduced as H. R. 5991) placing in the coastal states leasing authority over submerged lands within their traditional boundary lines and leasing authority in the Federal Government over the areas on the continental shelf beyond, and dividing between such states and the federal government the bonuses, rents and royalties derived from both state and federal leases. This bill outlines a sound leasing policy. It likewise offers a reasonably fair solution of the problem from the standpoint of the federal government, the states, and the bona fide holders of leases from the states.

Q. *What type of leasing policy and lease provisions will encourage development of continental shelf areas brought under federal control?*

A. A sound leasing policy should at the outset recognize that the oil and gas resources of the continental shelf can best be developed by the private petroleum industry which, through individual initiative and the risk of private capital, has supplied the oil needed for our peacetime economy and for two world wars. Equity and the public interest require that leases heretofore issued by the states be recognized. As to new leases, a desirable policy would involve the sale of leases covering units reasonably compact in size upon competitive bidding, without restrictions on the total acreage which may be held by any one operator, and upon definite lease terms with royalties fixed at one-eighth and with management of operations vested in the lessee. Leasing provisions of this type have secured development of both private and state lands in the past and are likely to encourage operations and secure the best results if applied to continental shelf areas.

Industry and the DEAD HAND OF FPC

By AL REESE, Managing Editor

THE STORY behind the defeat of the Kerr Bill is the story of our industry's failure to educate the public to its problems. It is also the story of how the Federal Power Commission slowly accumulated vast power over the gas industry in defiance of the original Natural Gas Act and the majority of congressmen who have served in recent years. Perhaps never in U. S. legislative history has any other principle received such constant support from the Congress and still failed to become the accepted law of the land.

FARMER JONES is a worried man.

Cause of his concern isn't his flock of chickens, of course. No, sir. They're laying all over the place and the government is buying the eggs and storing them in caves.

And certainly he isn't worried about his excellent stand of wheat or his cotton patch or potatoes or peanuts. Time was when a man couldn't be sure what his products would bring, but not now. Government price supports take care of that.

Even his children—five of them, six come fall—are a financial blessing when a fellow starts figuring his deducts.

Yes, just about everything a farmer can raise these days means money from Washington, and the more he raises, the more money.

But there is one exception, which is why Farmer Jones is fretful. In a clearing in the corn over on the south 40 acres is a gas well, and that could mean a wad of grief from now on because some how or other ol' Harry and the boys up in Washington have got it in for this gas business.

Farmer Jones keeps pretty well abreast of affairs through the newspapers, radio and magazines, and despite a lot of balderdash he has heard and read, he realizes that Harry Truman's veto of the Kerr Bill means his future in the gas business now rests squarely in the dead hand of the FPC.

Farmer Jones knows something about the Federal Power Commission. He knows, for instance, that while other government agencies have been holding up the prices on his other products, FPC has been hammering down the price of gas until now the over-all cost to the consumer is 12 percent less than it was 10 years ago.

(Funny thing why Harry and the boys should want a man to get high prices for what he produces on top of the ground and low prices for what he produces from beneath the same ground.)

And then, of course, prices could go even lower. Suppose FPC moves in and declares him or his lessee a utility. (Farmer Jones is a little awe-struck by this thought. Imagine him and his one little old gas well being a utility just like all these multi-million dollar outfits.) Anyway, if he were a utility, that would limit his profit to 6½ percent of his investment. If his lessee were a utility, its profit would be limited to 6½ percent, and that would limit Farmer Jones' return through royalties. His well is shallow and didn't cost much when it was drilled a year ago, so a 6½ percent return wouldn't keep him in hen scratch.

Farmer Jones has had some experience with government red tape and application blanks and he squirms a bit at the thought of the mountain of bookkeeping he might have to plow through if he became a utility. Then he has a brighter thought. With 2300 independent gas producers selling to pipe lines, FPC would have to hire a thousand people to keep up with the book work if it made everybody a utility.

Shades of Hitler! How did FPC get so much power, anyway?

Shift in Power

The answer to Farmer Jones' question is woven through one of the most incredible chapters in the history of U. S. government—a period which saw the executive and judicial arms so completely usurp the powers of the legislative branch that they have thwarted the will of a nation as expressed 4 times by the House of Representatives, twice by the Senate, and once by President Roosevelt.

The fiasco began in 1938 with passage of the Natural Gas Act, which said its provisions "shall not apply . . . to the production or gathering of natural gas."

It ended—or at least reached a painful pause—just 12 years later with veto of a bill which said exactly the same thing except in words that attempted to clarify a sentence which once seemed classically clear.

(Under the Kerr Bill the provisions of the Natural Gas Act would have applied in every way, and to every operation and every sale to which it now applies, except a sale of natural gas at arm's length* made during or at the conclusion of production or gathering, or except a sale of natural gas other than at arm's length if followed by a sale at arm's length during or at the conclusion of gathering operations. All sales made in interstate transmission for re-sale after gathering had been completed would have been subjected to the same regulation as at present. The proposed amendment would not in any way have changed the rate-making jurisdiction actually exercised by the Commission.)

The confusion and despair now lying upon the over-regulated industry is in sharp contrast to the tranquillity of the non-regulated industry in 1938. When on June 21 of that year President Roosevelt signed the Lea Bill, making it the Natural Gas Act and the law, the industry had just gone through a remarkable period of growth. Between 1926 and 1937, marketed production had increased from 1.31 trillion cubic feet to more than 2.5 trillion cubic feet. Natural gas reserves in 1929 were estimated at 62 trillion cubic feet. Ten years later, proven reserves were 165.9 trillion cubic feet.

All this was accomplished without the guiding hand of an omniscient FPC and despite the depression of the 1930's.

There was, however, an obvious need

*An arm's length transaction is one in which the seller has no interest in or control over a product after the first sale.

CLIPPINGS FROM THE KERR BILL'S SHROUD

Boom Town

Kerr Makes New Move for Oil

By Drew Pearson

Bible-quoting Bob Kerr of Oklahoma is really rolling up the bulwarks to protect his oil and gas interests.

Robert Kerr

Senator Kerr's oil and gas lands are valued at approximately 100 million dollars and his gross income is about 14 million dollars. The net income from his Kerr-McGee Co. last year was $1,218,627, on which the company paid only $6049 in taxes. His preferred stock earned $22.63 a share and his common stock $1.40 a share—all of which isn't bad for a Senator.

However, the gentleman from Oklahoma is not content with the lush profits and low taxes. He has already put his brother, Aubrey Kerr, on the Federal payroll with the RFC. He has been lobbying ceaselessly to pass the Kerr bill which would increase the price of natural gas to almost every Northern city—and also increase Kerr dividends.

But on top of all this, the Senator now wants to appoint a Federal judge who for years has been on the pay of the oil companies and who—human nature being what it is—might find his sympathies on the bench leaning toward his former clients.

The proposed judge is popular W. R. (Bob) Wallace of Oklahoma City, long-time attorney for Magnolia Oil ...

On the Other Hand

Kerr Bill Not Sliding Through Senate With Anticipated Ease

By Lowell Mellett

The battle in the Senate over the Kerr bill has grown a bit grim this week. The measure designed to take away the Federal Power Commission's authority to regulate the price of natural gas is not having the easy sailing contemplated by the associated Senators from the Southwest. When they brought it onto the floor last week it was thought that two or three days of debate would suffice to dispose of the matter to the satisfaction of the bill's sponsors. But it isn't working out that way. Indications now are that the vote will not be obtained until next week. Opponents believe that every day of debate lessens the bill's chances. Apparently ... have ...

Lowell Mellett

turn taken in the battle is that a number of Republicans have come to see a good political issue in the case for continued regulation of natural gas prices. Last week the Kerr forces claimed 16 Republican votes. The number, according to one Republican's personal check, has been whittled down to a maximum of 13, with not all of those firmly committed.

On the Democratic side an interesting undercover campaign has been going on. The rumor—and nobody has been able to make it anything more than that—is persistently spread that the President is prepared to withdraw his opposition to the bill. Counter-assertions, on equally uncertain authority, that the President still stands firmly against any change in the regulatory power of ... Power Commission.

Vicious Rumor

Another ...

Gas Barrage

Proponents of the Kerr natural gas bill scheduled to come up today in the Senate are trying to have their cake and eat it too. They contend that this bill, which would amend the Natural Gas Act specifically to exempt so-called independent gas producers from Federal Power Commission regulation, would not take away any of the jurisdiction that the FPC now possesses. If that were the case, why would there be any need for a bill of exemption?

Natural gas producers are of two kinds—producers affiliated with pipeline companies, clearly under FPC regulation, and ... independents. "Independent" in this ... is something of a misnomer. Although there are many small producers, a few large companies do most of the business, and some of the largest operators are oil companies. The authority of the FPC to regulate sales by independent producers destined for interstate commerce was affirmed by the Supreme Court in the Interstate case in 1947. It is true that the FPC has not actively regulated such sales in the past—principally because prices were ... unreasonable—but it has not relinquished ... Indeed, it is now using ... price proceedings against ... Co. ... others, has ... bill is ...

Charm Peddler

At another point, Kerr suggested that Senator Paul Douglas' arguments "would cause the junior Senator from Illinois to become a joint author of the bill."

"God deliver us from that!" cried Douglas.

"I am sure that He will—to our mutual gratification," bristled the Senator from Oklahoma. "... would like to be with the Lord, ... would like to be with the Senator from Oklahoma," ... "but not on this ..."

Political Economy

Kerr Natural Gas Bill Would Exempt A Monopoly From Control, Rennies Say

By Ysabel and Robert Rennie

TODAY the Senate will vote on the Kerr bill to exempt independent gas producers—that is, those not affiliated with interstate pipelines—from federal price regulation. A similar measure has already passed the House.

Opponents of the bill say it ... add hundreds of millions ... a year to the con... Senator Robert ... himself an ...

indicated that the Federal Government does.

By 1948, as more and more Northern cities were joined by pipeline to gas fields, prices were rising so rapidly that a majority of the commission decided some regulation would be necessary. The Kerr bill, by denying the right to fix gas prices, would in effect create a no man's land between Federal and State authority in which neither would have jurisdiction over the price of this natural resource.

IN DEFENDING his bill, Senator Kerr has said that long-term contracts and competition among independent producers would prevent unreasonable increases in the price of gas.

Nevertheless, contracts have not prevented a rapid rise in ... the last three years, and competition is simply no factor in the gas picture.

A pipeline joins a city with a certain field, or perhaps two or three fields. The producers in those fields are in fact in a monopoly selling position with regard to the pipeline and the city which buys the gas. Once the pipeline is laid, it cannot go elsewhere for gas if the price seems unreasonable.

All other stages of this continuous monopoly are regulated: the pipeline is controlled by the Federal Government, and the city gas company by a public utilities commission. But this control becomes a mockery if the field itself cannot be regulated.

... AND OIL producers ... gas is much un... point out that ... gas is only ... as bitumin... as expensive ...

... Chief Justice Vinson said ... interstate case of 1947, ... onable charges exacted ... age of the interstate ... become perpetuated ... in fixed items of ... st be covered by ... subsequent pur...

... our opinion, ... because it ... price of gas but ... old exempt from ... control what is in fact ... monopoly at all stages ... production and distribution ... is both cheaper ... cleaner than other fuels ... seems far better to give the ... efit to 40 million consumers ... not to a handful of ... who by virtue of a natural monopoly are in a position ... high prices. This is not ... of economics, it ... of equity.

Action Near on Gas Act

Final Test Due on Unemployment To Curb FPC Regulatory Authority

By Thomas L. Stokes

After four years, a final test is due shortly in Congress on proposed amendments to the 1938 Natural Gas Act which would break down regulatory authority over natural gas long exercised by the Federal Power Commission and would open the way for boosts in price to 40 million consumers.

Thomas L. Stokes

For the first time, a bill which would have these results now has reached the floor of the Senate. Twice the House passed similar measures—in both the 80th Congress and the present 81st. The Rizley-Moore bill, so-called, of the 80th Congress, the first vers... was killed by the Senate ... state Commerce Commi... the second version, a m... slipped through th... last session and ... action.

The purpose ... supervision ... FPC "arr... tural ... ducers ... commerce ... that there ... affiliation be... buyer and the ... independent ba...

Oil Companies ...

Big oil companies ... the bulk of the Nation ... gas reserves, are push... amending bill. They would ... handsomely. They are pow... politically ...

Representative Crosser and four other members of his committee said in a minority report that the Harris bill, which was passed, "by freeing a large segment of the industry from regulation, would benefit primarily a few large corporations which, because of their monopolistic control of gas reserves in the Southwestern States, would have almost unfettered power to fix the price of ... ing interstate tra...

Neither ...

Kerr Natural Gas Bill Due for Close Vote In Senate Today

By the Associated Press

A bitterly contested bill to limit Federal regulation of the natural gas industry approached ... today in the Senate.

Senator Kerr, ... Oklahoma, autho... and other ba...

Senate Votes Kerr Bill to Curb FPC Control Over Gas Rates

Party Lines Split in 44-38 Passage Of Act Aiding Independent Producers

The Senate voted 44-38 yesterday to bar the federal power commission from regulating rates charged by independent natural gas producers, when it passed the controversial Kerr bill.

The so-called independents are ... which have no distribution ... of their own. They sell to ... utors.

commission, or whether they should pay reasonable prices set by the law of supply and demand."

Fulbright then added:

"It seems to me that it is a great reflection upon the integrity of our press and our so-called ... columnists and the argu... and viewpoints of those ... this bill have been ... suppressed."

The Hou...

... Lines Broken

... vote, climaxing some two ... bitter debate, split party ... open.

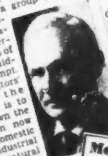
... Douglas (D) of Illinois ... the opposition. He ... bill would lead to ... to ...

On the Other Hand

Gas Producers' 'Grab' for Millions Coming Up in Senate This Week

By Lowell Mellett

The Senate is to be the scene this week of an unpleasant spectacle, a sordid, unblushing grab for money by a group of big oil and gas producing companies, with certain members of the Senate aiding the attempt. The Senators' part in the scheme is to break down the protection now given domestic and industrial users of natural gas by the Federal Government. House...



sailable. But digging deeply into his past, his opponents unearthed material he had written long ago for labor newspapers and were thereby able to caricature him as a deep-dyed radical, not safe to have around.

The "Red" issue did for Mr. ... Olds. Senators could register their shocked indignation and vote against him, without going into the real reasons for the attack on him.

But now there is no Red issue ... The Senators from Ohio, Michigan, Wisconsin, Missouri, Indiana or any of the 35 States to which natural gas pipelines have already been extended, cannot make the present question one to grow pur... ple in the fac... and the ... them ...

Douglas And The Kerr Bill

By Marquis Childs

Gas Monopoly Fight

BEING A United States Senator is really tough these days if you take your job at all seriously. In an earlier day, some highfalutin' oratory got you over the rough places.

But in the face of an issue as that presented by Senator Robert Kerr's bill to take the independent producers of natural gas out from under Federal regulation, oratory is not enough. It takes hard, thorough, conscientious digging into the facts and figures that spell out certain basic economic relationships in this country.

That hard, thorough, conscientious digging is what Senator Douglas of Illinois has supplied in the controversy now ... toward a climax. His ... and the part he ... in the give and take ... constitute a remark...

Bible-Quoting Bob

The more you see of likable, Bible-Quoting Bob Kerr, the more you realize he is no novice from the bush leagues of Oklahoma, but one of the smartest Senators ever to come from that State. He is particularly smart at looking out for Bob Kerr.

Not only has smiling Bob kept the Senate in a turmoil over his Kerr bill, expected to increase the cost of natural gas to Northern cities—and increase his own gas profits. Not only is he appointing a big oil company attorney, W. R. Wallace of Magnolia-Socony-Vacuum to the Federal Court. But in addition Kerr may profit from an Oklahoma highway to be financed by the RFC by selling it "black..." from the Kerr-McGee Co. Furthermore, Senator Kerr has ... his brother, Aubrey Kerr, ... spot as Oklahoma counsel ... RFC, where he passes upon ... ters affecting the State of ...

... Oklahoma toll road to which ... Kerr's company hopes to ... mix called "Black-... from Oklahoma ... Application has ... the Reconstruction ... for a $35,500,000 ... be the full cost ... RFC has coun... posal that the ... put up five to ... concrete it ... more ex... or Kerr's ... per but ... McGee ...

Merry-Go-Round

Kerr Seen Overselling Gas Bill

By Drew Pearson

The natural gas industry's smoothest salesman will learn today whether he has made his biggest sale.

He is amiable, persuasive Senator Bob Kerr, Oklahoma Democrat, who has been trying to sell the Sen... on exem... natural ... duce...

... been ... from Se... ing, cajo... of sales tal... will give thei... vote.

Already a m... Kerr has a financ... own salesmanship. ... his one year in the Se... voting record has been f... lic interest. But in the gas ... gain would be the public's l... the consumers must eventually ... any resulting increase in the cost ... gas. Certainly the reason the natural gas companies want to escape Federal regulation isn't to reduce prices.

Whatever the outcome, the Senator from Oklahoma has ...

Natural Gas Again

The seemingly perpetual efforts to remove independent natural gas producers from Federal regulation are coming to a head again in the Senate. The House already has passed the Harris bill, which would amend the Natural Gas Act of 1938 to eliminate Federal Power Commission jurisdiction over the sale of natural gas to pipeline companies for transmission in interstate commerce. The Kerr bill, scheduled to be called up shortly in the Senate, is the companion piece. Inasmuch as some 86 percent of the country's natural gas reserves are held by so-called independent producers—that is, companies which do not operate pipelines—in all probability the effect of the bill would be to raise gas prices down the line, with the consumer ultimately paying the bill. ... the flight from coal for heat and power ... more pronounced. ... the Kerr bill ... significance. Proponents have ... -bid purpose is to pe... Kerr himself is a ...

THE KERR BILL IS NOT A GOOD BILL

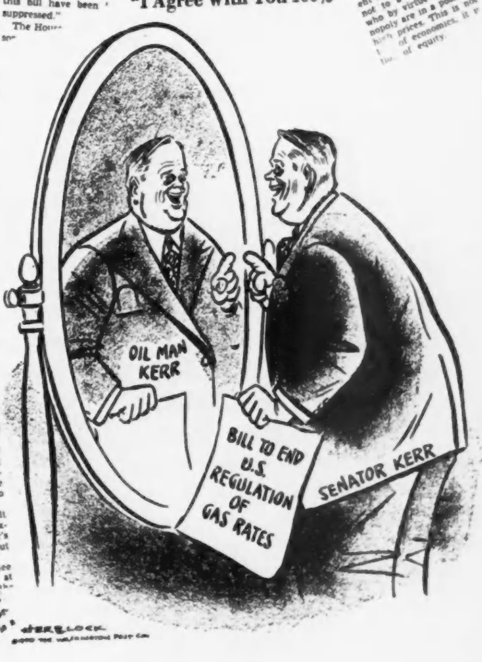
Most people in the oil and gas business think it would be ... industry if the Kerr bill is enacted into law. This important bi... out or diminish existing jurisdiction of the Federal Power Com... certain phases of the natural gas industry, among other considerati...

We think Congress would make a great mistake if it passed the ... It would hurt the oil industry in the long run, by strengthening the ... large corporations (especially pipeline companies) whose operations ... perilously near monopoly of the illegal sort that gives the busines... The Kerr bill would hurt small producers of oil and gas, who a... to see daylight ahead as the Federal Power Commission beg... long-distance gas pipelines in somewhat the manner the Interstate ... Commission polices railroads. There has to be some powerful fo... call the turn on these huge interstate transportation systems, whe... on the ground or underground.

... bill is a long step backward, not forward. It probably will d... it does—because Little Business which would be hurt will fight ... vigor and consumers of gas who would be hurt will fight it ... senators and congressmen.

... gives the impression of favoring the Kerr bill (surel... Senator from Oklahoma can be trusted to represent the oil ... but we'll bet most people in the oil and gas business ... is killed. As we've stated before, we like the ... anything that fosters monopoly. We think ... feel the same way. Because of that ...

"I Agree With You 100%"



for regulation of an industry that was growing into the interstate field and thus out of jurisdiction of the states. In searching for a pattern from which to fashion the desired law, Congress naturally turned to the regulations governing railroads and other carriers operating in interstate commerce. It was intended to regulate the earnings of gas pipe lines engaged in transporting natural gas in interstate commerce and in selling such gas for resale for ultimate public consumption. Those who drafted the Act had no more intention of granting jurisdiction over gas before it entered an interstate line than the originators of the railroad regulations had of controlling the price of steel or grain before it went into interstate transportation.

Congress gave FPC jurisdiction over the Act with duties approximately paralleling those of the Interstate Commerce Commission.

The provision in the Act which was to cause the industry so much distress is contained in Section 1 and is as follows:

> "(b) That provisions of this act shall apply to the transportation of natural gas in interstate commerce, to the sale in interstate commerce of natural gas for resale for ultimate public consumption for domestic, commercial, industrial, or any other use, and to natural-gas companies engaged in such transportation or sale, but shall not apply to any other transportation or sale of natural gas or to the local distribution of natural gas or to the facilities used for such distribution or to the production or gathering of natural gas."

Two words in the last line of the paragraph, "production" and "gathering," were and are at the core of the confusion, for it was by vitiating those words that the FPC was able to march up the road to great power, a docile Supreme Court leading the way, under the eyes of a once indifferent, now despairing oil and gas industry.

Explicitly forbidden by the Congress to directly control and regulate production and gathering, the Commission has attempted to diminish the meaning of the 2 words as to signify only the management of drilling rigs, pumps, pipes and flow tanks. It has sought to establish—though it has not yet attempted to exercise—authority over all field and well prices for natural gas. Furthermore, since the production of gas and oil are inseparable, there is an obvious threat of ultimate authority over the entire industry. Indeed, this very threat was plainly spoken 10 years ago. On February 7, 1940, Chairman Leland Olds of FPC told the Congress: "It is my recommendation that appropriate federal legislation be enacted completely controlling production and conservation

The red segment represents the producer's share of every dollar spent by the housewife on gas. If the well mouth price should suddenly be raised by 30 percent, the residential rate would go up less than 3 percent.

of natural gas or other hydrocarbons in the United States."

Since oil is also a hydrocarbon, Olds was advocating the regulation of both oil and gas.

However, it was no swift, clean rush that carried the Commission to the heights of power. It was more of an inching, halting, crab-like sidle that allowed FPC to coo over its shoulder at industry that nobody was going nowhere, not now, not ever.

Shortly after Olds recommended that the federal government take over the regulation of gas, FPC soothed the industry on the occasion of the Columbian fuel case with the assurance that it had no jurisdiction over arm's length sale of gas by producers.

From then until 1945 was a time of small but ceaseless movements by FPC. Only occasionally, as during the wartime natural gas investigation, did the industry pause in its gigantic task to cast a suspicious eye upon the Commission.

Then, emboldened, FPC stepped out with the Colorado Interstate Gas Company case. In that case the Supreme Court held that production and gathering properties of an affiliate of an interstate natural gas transmission company and which sold gas to the transmission company was properly included in the latter's rate base set by FPC for ratemaking purposes. Result was, Colorado Interstate and its affiliate were treated jointly and were limited to a return of 6½ percent on their investment.

That fully awakened the industry but did not send it into decisive action. This was accomplished when FPC took another long step in the Interstate Natural Gas Company case. Following its crafty technique of testing the weakest link in the opponent's armor, FPC had pounced on Interstate because it was a marginal case. Interstate's main pipe line transports gas southward from the Monroe field of North Louisiana to various distributing companies and industrial consumers in Baton Rouge. But for practical reasons involved in laying the line, the carrier goes through a part of Mississippi, thence back to Louisiana. Therefore, said FPC, Interstate is operating in interstate commerce.

On June 10, 1947, the Court held that sales made by Interstate (which was already a natural gas company as to its transportation operations) at the wellhead or during or at the conclusion of a gathering operation, were sales in interstate commerce. In so holding, the Court used language that would seem to make sales by all producers of gas subject to regulation.

This time FPC's marching boot had crunched on every toe. Industry was ot only awake; it was howling. And, of course, FPC was on the spot with a sunny smile and a sweet assurance. Bills thumped into Congressional hoppers as efforts were made to clarify the Natural Gas Act. And at the hearings on every bill FPC reiterated its oft-stated view that independent operators who produce or gather natural gas and sell it at arm's length to natural gas companies subsequently transporting such natural gas in interstate commerce are exempt from the provisions of the Natural Gas Act.

Some in industry were gullible enough to swallow this; others were doubtful. Here was a power-grabbing bureaucracy saying it had no intention of exercising authority apparently given it by the Supreme Court.

Yet FPC insisted this was so. As evidence of its good intentions it sponsored the Priest Bill to clarify the Act. The bill was unacceptable to industry, so FPC tried a new tack—its famed Order 139. The order disclaimed any intention to exercise authority over arm's length sales by producers. This order, said FPC, "is designed to relieve any existing uncertainty regarding the Commission's position that it will not seek to assert jurisdiction over the sale of natural gas to interstate pipe lines by independent producers or gatherers."

This order was issued August 7, 1947.

Six months later, on February 6, 1948, Olds did another amazing turnabout by recommending to the Senate Commission on Interstate and Foreign Commerce that the Natural Gas Act not be amended in any respect.

Just four months later, on June 9, Olds again did an about face. In reporting with Commissioner Claude Draper on the Reed Bill, Olds said there was no desire to subject the independent producer and gatherer to regulation by FPC.

Up to this point FPC had been patting the industry on the back with

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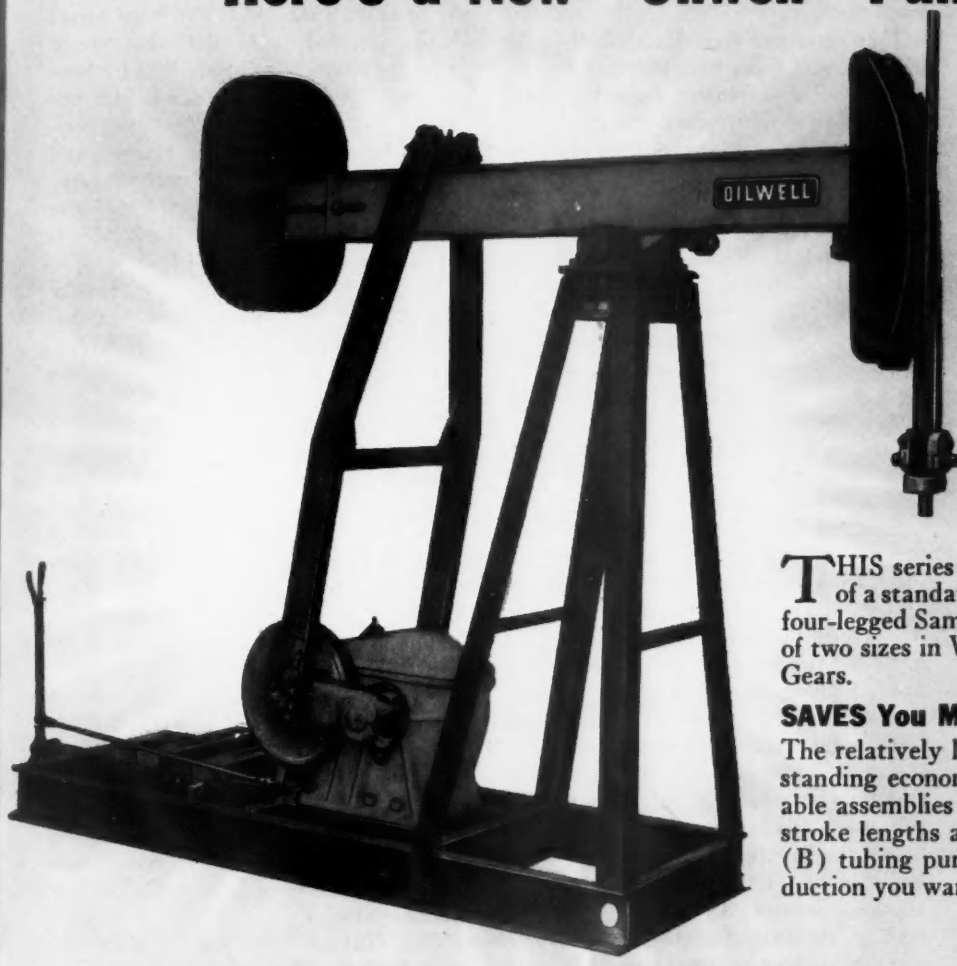

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2	5-A-3	24,100	3,225	22½, 25-3/4, 30	20	5
3	3-A-4	16,000	4,025	18, 20-5/8, 24	20	3
4	5-A-4	24,100	4,025	18, 20-5/8, 24	20	5

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words and kicking it on the shins with action. But on March 10, 1949, FPC apparently reversed its previous policy and exempted Delhi Oil Corporation, a gas producer, from regulation. However, industry was not deceived. Delhi's sale involved 100 million cubic feet of gas per day for 25 years, one of the largest single gathering operations in the U. S., and had FPC withheld this amount of gas from the hungry market, it would have been the target for widespread criticism. The Commission was to be repaid many fold at the grand showdown a little later for yielding a trifle at this delicate moment.

Throughout this long-time vacillation by the FPC, it had revealed nothing of its ultimate goal beyond the broad outlines voiced in 1940 by Olds when he recommended regulation of the oil and gas industries. Then, on April 25, 1949, the Commission pointed out its true, immediate target, and to no one's surprise it turned out to be the larger companies —those long-time whipping boys of an administration which believes it is sinful to be big. The Commission recommended to a House subcommittee that the large independent producers and gatherers remain subject to regulation, but that the small ones not be subject to regulation. It goes without saying that FPC would be the one to declare who is big and efficient and hence in need of regulation and regeneration.

Meanwhile, industry's first frantic reaction to the Interstate decision had gelled to a determination to amend the situation with the aid of a friendly Congress. In July, 1947, the House passed by a vote of 254 to 64 the Moore-Rizley Bill, which died in the Senate subcommittee, principally because it would have limited FPC's authority over sales made by natural gas companies operating in interstate commerce.

On May 27, 1948, Senator Reed of Kansas introduced a bill which was not acted upon.

Then came the Kerr-Harris Bill, early triumph, and final, humiliating defeat.

The choice of Senator Robert S. Kerr of Oklahoma to introduce the gas bill in the Senate is manifest evidence of the industry's honest intentions as well as its starry-eyed notion that the measure would receive no considerable opposition. Kerr-McGee has full or partial interest in more than 600 producing oil and gas wells with an annual production of about 1 million barrels of oil and 31,207,500,000 cubic feet of gas. The company has accumulated proven reserves estimated at 1 trillion cubic feet of gas, which is well over ½ of 1 percent of the nation's known supply.

Had there been any intention of hijacking the U. S. housewife by doubling her gas bills, or if there had been any forewarning that such charges would be hurled, Kerr certainly would not have introduced the bill; he probably would have disbarred himself from voting; and he may have taken himself completely out of Washington, where the sight of him would inflame the opposition.

But to the industry supporters in Congress, it was all routine. Kerr himself used that very word in testifying before the Senate subcommittee. "Frankly," said he, "I think the amendment is routine, Senator. I think it is merely routine, Senator, first to effect the ancient principles of free enterprise in America; second, the interest of the states in the exercise of their powers in their fields; and third, in the matter of clarifying language which, as Senator Reed has so aptly said here, there was no question about when it was passed."

Kerr had introduced the bill because he knew the intricacies of the problem and because he had been asked to do so in a resolution passed by the Oklahoma legislature in March, 1949.

He thought it was routine because he believed President Truman was committed to sign the bill. (The *Wall Street Journal* declared on April 17 that one of its representatives had been told by Senate Majority Leader Lucas before the measure was passed that it had been "worked out at the White House" and was acceptable to the President. Another administration lieutenant said the President's chief counsel, Charles Murphy, actually wrote the bill.)

He thought it was routine because the intent of his bill had, in different forms, been approved 3 times by the House of Representatives and twice by the Senate.

He thought it was routine because the Harris Bill, companion measure to the Kerr Bill, had galloped through the House by a vote of 183 to 131 in August, 1949.

Senate action was delayed, then an amendment was added, and now hearings were being held.

Then, overnight, a little matter of routine became a nightmare for Kerr and the industry.

Sensation-hungry newshawks turned from the Kremlin to Kerr and gleefully massaged him with typewriter ribbons of sandpaper. Here was rare, rich fare, indeed: The powerful, vested interests snatching at the pennies of shivering little people in gas-heated hovels. Newspaper empires have been built on less readable stories.

The National Association of Municipal Law Officers, Americans for Democratic Action, the PAC, and more, many more, hooted and sneered.

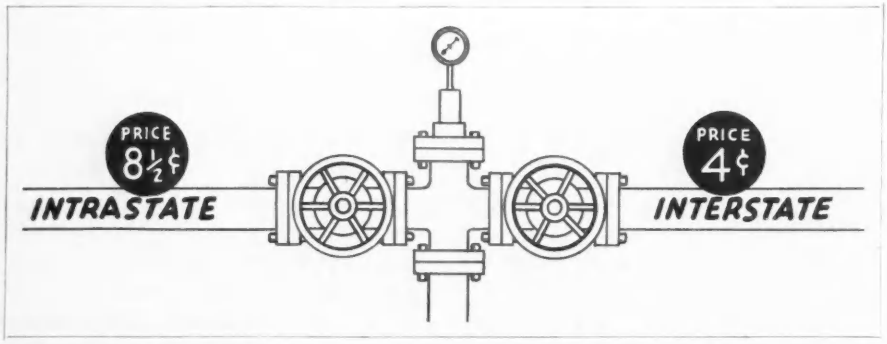
Eighteen mayors who had gathered in Washington to discuss crime looked up to see what all the rumpus was about, and soon more than one Congressman was getting a telephone call from the mayor of the largest city in his constituency. "Say, are you going to let those dirty names double our gas bills?"

Whether this vicious, concentrated attack on an issue that had never before aroused even the casual interest of the public was a happen-so or whether someone deliberately turned loose the wolves is something the industry has strong but unproved opinions about.

Industry's stunned spokesmen shook off their surprise and fought back. Kerr himself went on the radio; but his voice was a whisper in bedlam.

The bill squeaked through the Senate, 44-38, and went back to the House while the roar from the press swelled higher, as did the mountains of acrimonious mail from home.

This bill was admitted by all to be a better bill than the Harris bill which had passed a year before by 52 votes. When the voting began it was supported by the majority leader, the majority whip, the minority leader and the minority whip. Speaker Sam Rayburn left



One reason for the opposition of some interstate gas companies to the Kerr Bill is illustrated here. Testimony before the Senate subcommittee presented the hypothetical case of a well supplying gas into 2 lines at greatly varying prices. Owner of the well is Company A, a natural gas pipe line company. Owner of the gathering lines is an affiliate company. For all gas sold to the intrastate gathering line, Company A is entitled to the contract price or the prevailing market price, which is assumed to be 8½ cents per Mcf. For all gas sold into the interstate line, which is regulated by FPC, Company A will get only 4 cents per Mcf, it was testified. This discrimination, it was argued, could be removed only by a bill that would limit FPC jurisdiction over companies now subject to its regulations.

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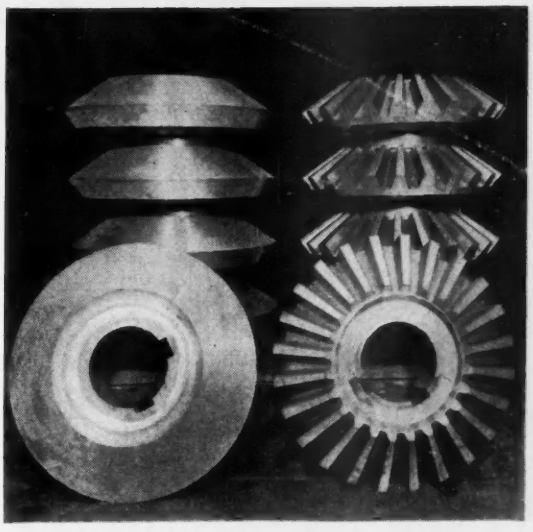

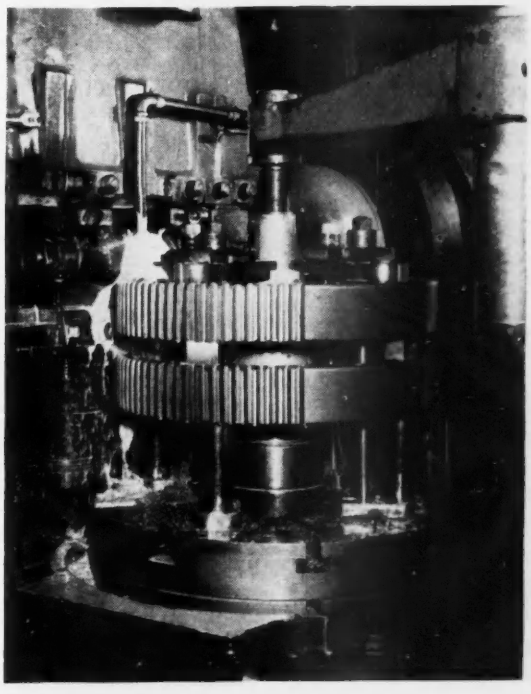

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the chair and declared in a rare speech: "In my opinion this bill will not raise the price of natural gas to any consumer by one red cent."

Yet so rapidly were the industry's backers falling away from a "routine" measure which had suddenly caught fire that the measure barely passed, 176 to 174.

That transferred to the White House this pressure which had grown so great that it could have been withstood by few except a president intent upon justice and heedless of political expediency.

Harry Truman vetoed it, saying: "There is a clear possibility that competition will not be effective, at least in some areas, in holding prices to reasonable levels. Accordingly, to remove the authority to regulate, as this bill would do, does not seem to me to be wise public policy."

Price Argument

The furore against the Kerr Bill hinged on the argument that it would leave consumers at the mercy of the independent gas producers, who could then charge any price they desired. The fallacy here is that the consumer has ALWAYS been at the mercy of the independent producer for the reason that the independent producer has NEVER been regulated. And what has been the awful result? The retail price index for gas in 1949, with natural gas having been approximately 84 percent of the total volume, was less than 2 percent above the 1935-39 average. The wellhead price of natural gas over the past 20 years, 1929-49, declined from 8.2 cents per thousand cubic feet to approximately 6.7 cents.

And what of the future? If freed from the threat of FPC control would the independents hike the price of gas? The answer is in the law of supply and demand. If freed of the FPC threat, the independents would literally glut the market. It has been reasonably estimated that fear of federal regulation has held up the offering in just one locality on the Gulf Coast of 20,000,000,000,000 cubic feet of gas.

By merely continuing its threat of control, FPC will be responsible for a price increase which must result from growing demand and static supply. With more and more independents afraid to offer their gas to the market, competition must sharpen for that which is available. Companies operating the interstate lines spend only limited amounts drilling for new gas as long as there is a cubic foot to be bought at any price. Reason is, if a company now under jurisdiction of the FPC spends $1 million to find $10 million worth of gas, the Commission will allow it a return of only 6½ percent of $1 million. But if the same company buys $10 million worth of proven gas reserves, FPC will allow it a return of 6½ percent of $10 million.

The supply-demand imbalance would be sharply worsened should FPC actually attempt to control the independents. Most contracts of recent date contain escape clauses which would cut off the gas flow the moment FPC tries to exercise jurisdiction.

However, some companies fear the Supreme Court would invalidate these clauses and actually force the sale of gas. Testifying before the Senate subcommittee on the Kerr Bill, Hayden W. Head, attorney for Southern Minerals Corporation, an independent, declared: ". . . I advised Southern Minerals Corporation that it should not take the risk of subjecting itself to the burden of federal regulation unless Congress clarified the Natural Gas Act of 1938 to remove the danger. Based on that opinion, Southern Minerals Corporation, having no other market, was forced to keep its gas wells shut in and suffer constant drainage from the wells in the Bentonville field with the possible loss of its entire gas reserves in the Richard King field. Further, it was necessary that it continue to flare into the air some of the gas produced from its oil wells."

It might be asked if it would not be better to accept the FPC yoke and 6½ percent on an investment rather than keep the wells shut in and drained by others.

The answer is that much gas comes out of the ground with oil. In such cases it is almost impossible to regulate one without controlling the other, and if both are controlled, the producer can be deprived of all future returns on his property by FPC's method of computing allowable profit by deducting previous returns from initial investment. A federal court upheld an FPC order in the Cities Service case in which the Commission required that the company's earnings from gas operations include an item of $380,000 realized by an affiliate in extracting liquid products from natural gas. In the Colorado Interstate case the Commission with Supreme Court concurrence, placed leases on about 47,000 acres having a market value of more than $3 million in the rate base at $4200 and Colorado Interstate was permitted to earn only about $300 per year on those properties.

One major argument for the principles of the Kerr Bill is that fair and equitable regulation of all independents is impossible. This is irrefutable because the business of producing and gathering oil and gas involves so many risks, hazards, and varying situations. The production of natural gas cannot be a utility business so long as 4 out of every 5 exploratory wells drilled are dry holes.

As Senator Kerr put it: ". . . it may be said that wide and unpredictable variations will occur in the face of discovery, in the failure of discovery, in the cost of discovery, in the cost of failure of discovery . . .

"It would be impossible for the Commission to determine what the future risks of any one operator would be. It therefore could not be determined what should constitute the rate base or a reasonable return therefrom."

Bad to Be Big

The answer to why FPC should have fought so long for authority it cannot administer may just possibly be found in the Commission's recommendation that the large independent producers remain subject to regulation, but that the small ones not be subject to regulation. Thus, FPC would sidestep the impossible task of regulating the thousands of small producers while effectively furthering the disintegration of the administration's anathema—the larger companies.

Minuscule though it be, the only hope for immediate relief from FPC is the Supreme Court. The fire ignited by a vituperative press and fanned by the veto of a vote-conscious president still flames so hotly that any congressman from a big city area who cuddles up to the gas industry would risk having his political pants burned off.

Because the presidential election is only 2 years off, this is a period of the bland smile, the sugary assurance, and it is therefore possible that industry will have time to reassemble forces and acquaint the public—not merely an emasculated Congress—with the true facts before FPC provokes court clashes by attempting to invoke its dread powers. The public must be made to understand that a plentiful supply of natural gas is endangered by the recent veto—AND WHY. The oil and gas industry has an educational job to do, and if it isn't done the industry will suffer—as well as the public.

If the industry fails to build a barrier of public enlightenment against the depredations of FPC, and if ol' Harry and the boys stay in Washington, then watch for the hand of friendship now being extended to curl into a menacing fist. Then indeed will Farmer Jones have bitter reason to conclude that he should have gone on raising corn, chickens and children and left that gas down where it was put by a beneficent Almighty who neglected to indicate that He was entrusting its disposal to the minor deities of the FPC.

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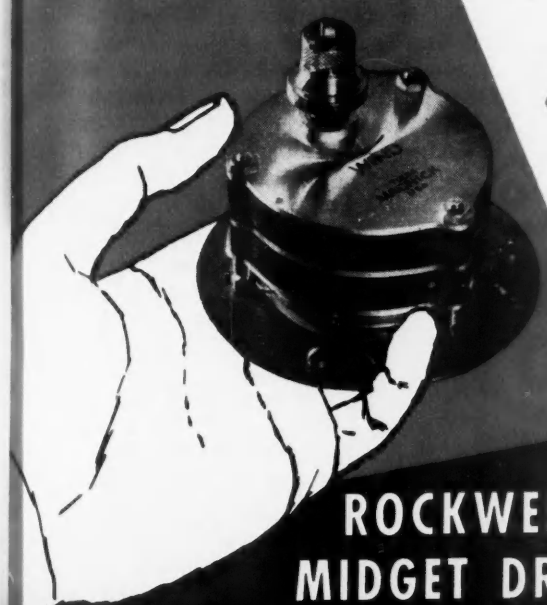

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Use to Grow Despite Natural Gas

By HENRY OZANNE
Eastern District Editor

BASICALLY, heating oil, moved by cheap water transportation, has a definite competitive advantage over natural gas that goes to market through costly transcontinental pipe lines. If the gas were sold in the Southwest at the same price as oil, in terms of heating value, it would not be economically possible to pipe the gas to the distant markets. These statements have been offered in forecasts that heating oil will continue to compete strongly for fuel markets, while current growth of natural gas marketing henceforth may show pronounced tapering off.

THE petroleum industry faces stiff competition from natural gas for the automatic heating market, Stanley C. Hope, president of Esso Standard Oil Company, recently told the annual convention of the Oil Heat Institute in Philadelphia. However, both he and Robert Gray, editor of *Fueloil and Oil Heat*, agreed that the oil burner industry would grow and prosper in the years ahead.

Hope said the industry must continue to import heavy fuel oil. "Refiners are trying to turn a larger and larger part of each barrel of domestic crude oil into the greater income producing, higher quality products. As a result, residual fuel oil is becoming less attractive from the refiner's standpoint and its output from each barrel of domestic crude is getting smaller and smaller."

Gray predicted that "for the next 2 or 3 years the gas industry is in a good way to install more central heating jobs than we do, but just slightly more. Beyond that, everything points to their falling off sharply and getting back to a more or less average pattern of former years, while oil heating can and apparently will go on climbing. The economics of the gas picture point to a one-time surge, and that's all."

Gray said: "It costs 5 times as much to move gas in a pipe line as it does to move the same amount of heat in fuel oil by water—either to the East Coast or over the inland waterways of the Midwest. If gas were sold in the Southwest at anything like its value in comparison to the oil that comes out of the same wells, it wouldn't be possible to move it East."

Gray offered a table to show possible new natural gas burner installations, 1950 to 1953 (Table 1.)

He said: "When this expansion period is past for the gas industry, there will naturally continue to be further growth but apparently at a lower annual rate. In the four postwar years 1946-1949, inclusive, average gas installations were 474,000 a year and after this present splurge the industry will conceivably settle back to some such number. Oil heating's average rate since the war has been 613,000 a year. That average should at least be maintained. For the first quarter of this year we were 19 percent above last year, and if we could hold that through the year we would do 730,000."

He said that because an area has much cheap natural gas in its cities, the area is not saturated for oil heating. For instance, the chief region where natural gas is now sold is in the Midwest, conspiculously in the big cities of Pittsburgh, Detroit, Cleveland, Cincinnati, St. Louis, Chicago, and Minneapolis. But the Midwest as a whole, Gray said, has been the fastest growing section for oil heating. The net number of oil burners in use in the Midwest at the start of this year was 19 percent higher than the year previous, while the rest of the country averaged only a 12 percent gain.

Gray quoted a survey by *Household* nationwide, showing the ratio of homes heated by various fuels. (Table 2.)

He concluded, "It is clear from the table that oil does just about as well in all city size groups, while gas is weak in the smaller places and gains strength with city size."

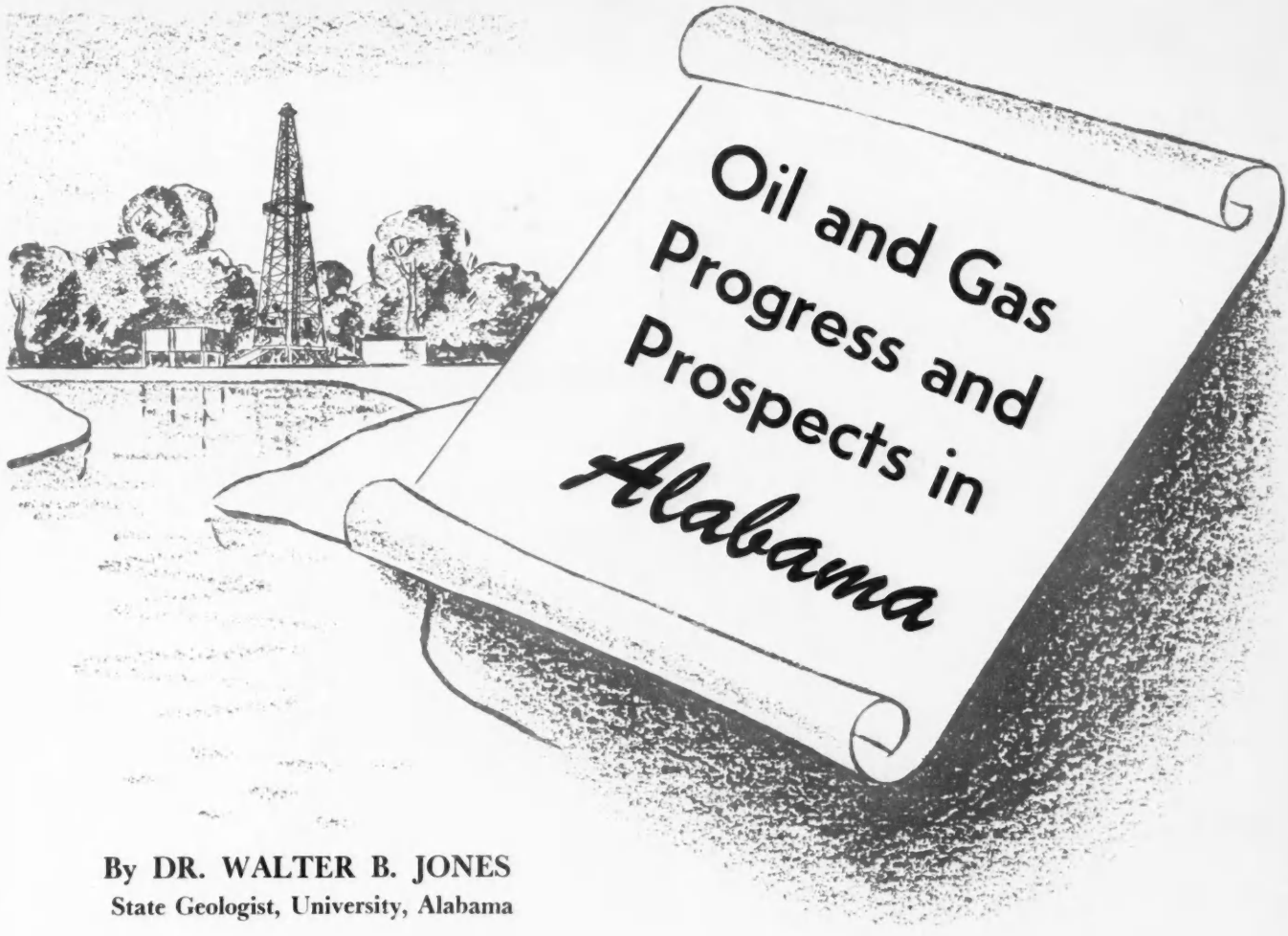
Gray cited a survey made by his publication in six "cheap gas" cities, Detroit, Chicago, Minneapolis, Des Moines, Omaha, and St. Louis, which found that "Among companies which sold both fuel oil and oil burners, their losses of oil customers to gas represented 1.1 percent of all their oil customers. Compared to this, those companies that sold only fuel oil lost 3.6 percent of their oil customers to gas during the year. Then the first group sold enough burners to gain new customers equal to 4.5 percent, so they had a net gain in customers for the year of 3.4 percent."

TABLE 1
POSSIBLE NEW GAS HEATING USERS
Based on Pipe Lines now Under Construction, Approved for Construction, or Probable. Assuming 25% of Line Capacity for Central Heating

	1950	1951	1952	1953	Total
East Coast	250,000	380,000	187,000	63,000	880,000
Midwest	320,000	254,000	181,000	55,000	810,000
Mountain	39,000	69,000	7,000	.....	115,000
Pacific	161,000	89,000	148,000	107,000	505,000
Total	770,000	792,000	523,000	225,000	2,310,000

TABLE 2
Percent of Homes Heated With Various Fuels, Central Heating

	PLACES HAVING A POPULATION OF:						
FUEL USED	2,500 or Less	2,500 to 10,000	10,000 to 25,000	25,000 to 50,000	50,000 to 100,000	100,000 to More	All Sizes
Oil	16%	23%	17%	24%	18%	17%	19%
Gas	7	12	14	13	29	21	17
Coal, Wood	77	65	69	63	53	62	64



Oil and Gas Progress and Prospects in Alabama

By DR. WALTER B. JONES
State Geologist, University, Alabama

WITH the completion of M. W. Davies et al 1 on the right bank of the Alabama River in the southern tip of Clarke County, Humble Oil & Refining Company has brought in Alabama's second oil field. At present, there are 42 producers in the Gilbertown field. Recent completion of a small gas well near Hamilton, in Marion County, gives promise of a commercial gas field. Last year, a shallow salt dome was discovered near McIntosh, Washington County. Thus postwar predictions of important events in oil and gas exploration in Alabama are coming to pass.

ALABAMA GAINED its second oil field through recent completion of a productive wildcat in southern Clarke County by Humble Oil & Refining Company. The discovery well initially pumped 86 barrels of 14-gravity oil per day from glauconitic sand in the Tuscaloosa formation, Upper Cretaceous age, at 5419-5429 feet. The new area is in the southwestern part of the state. That district also contains the Gilbertown oil field, Choctaw County, and a known salt dome near McIntosh, Washington County, and is believed to offer probably the best oil and gas possibilities of the various districts of the state.

Progress

CLARKE COUNTY DISCOVERY. The Davies well is very important, not so much for the amount of oil it produced in its two days on pump (86.4 and 100 barrels per day), but for the considerable thickness of beds containing oil. It is also of interest that the producing horizon is the glauconitic sand member of the Tuscaloosa formation, Upper Cretaceous age. The horizon is productive elsewhere in the Gulf Coast region. Until the Davies well, the Tuscaloosa sand section had been dry in the score or more wells which penetrated it. In the Davies well the first oil show was encountered at 4275 feet. From that depth to 7342 feet, 91 oil shows and one gas show were observed. Most of these were in thin layers and beds of sand and shaly sand, too thin to produce. However, 16 drill-stem tests were made, at various depths from 4275-85 feet to 7314 21 feet, before the 17th test brought in the well at 5419-29 feet.

Not much is known about the structure of the new field. It is thought to be an anticline. With North-South axis, parallel to and along the eastern margin of an extension of the well-known Jackson Fault. Actually, the structure may cross the Alabama River into the northwestern part of Baldwin County. It is apt to extend across the cutoff, separating Clarke and Baldwin counties.

The Davies 1 is in a swampy area, accessible only by water, except during very dry weather. Every item required for drilling and completing the well had to be shipped in by barge. The rig was located on a mound raised about 15 feet above the swamp floor. About 150 yards of causeway, similarly thrown up, connected the rig to a terminal at the river's edge, where a Bailey bridge permitted access from barge to ramp. Until more is known about the trend and production possibilities of the structure, it is unlikely that access roads will be undertaken.

The oil from the new discovery is heavy and black, with asphaltic base, of 14 gravity, corrected. Plans for marketing the oil are not known. Oils showing in some of the sands were much lighter in color and of much higher

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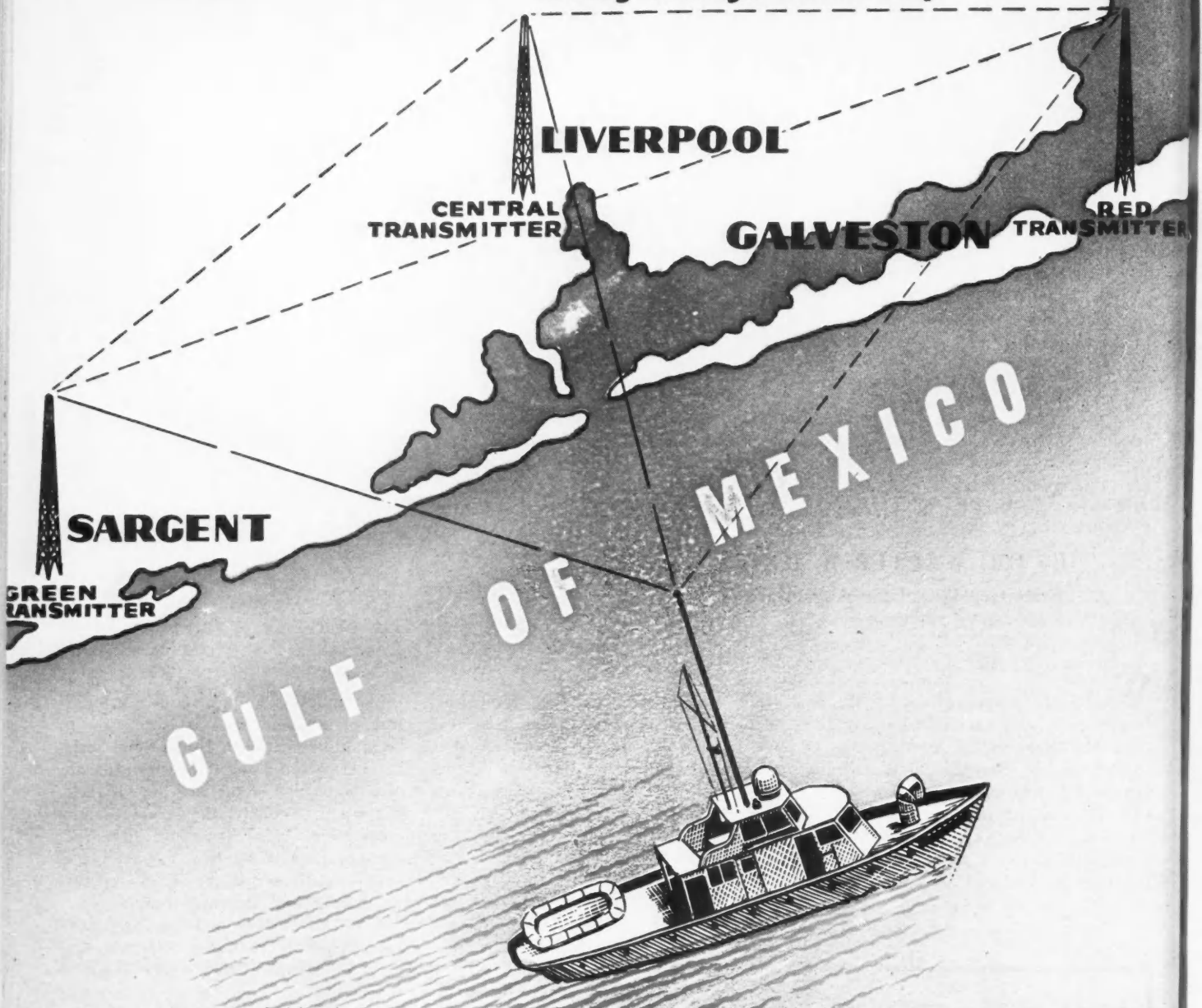

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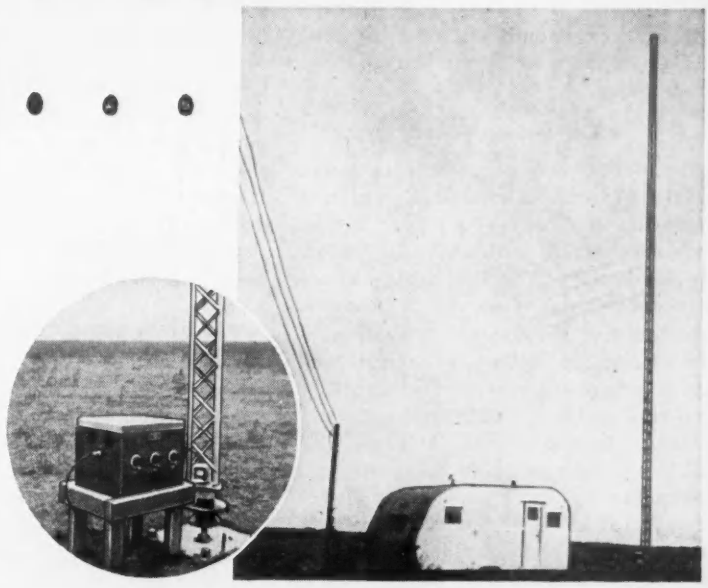

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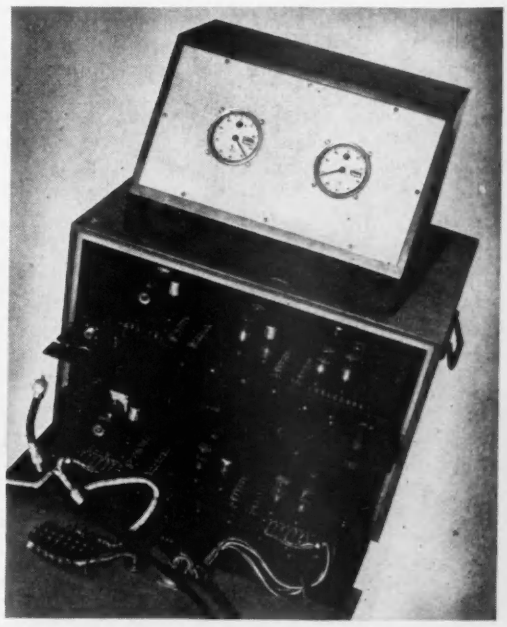

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HAMILTON GAS FIELD: Also new to Alabama's oil and gas industry is the gasser, Lewis 1-A, about 4 miles southwest of Hamilton, Marion County, brought in by Harry L. Cullet, February 20, 1950. While the well had a potential of more than 2 million cubic feet per day, its conservation capacity is figured at 400,000 cubic feet. The productive sand is Bethel sandstone, Mississippian age. The structure is thought to be a warp with northwest-southeast trend, perpendicular to the axis of the Appalachian Geoanticline.

Oil Shows Found

While not very important in itself, for the gasser is a minimum one, it is significant that several good oil shows were encountered both above and below the gas horizon. The field may produce both oil and gas. Only future exploration can give the answer to that question. Cullet is drilling a second well and contemplates others. The discovery well was completed at 1835-45 feet.

GILBERTOWN FIELD. This field was rather fully described in WORLD OIL, September 1, 1947[1] and data will not be repeated in detail here. Production is against or close to a fault plane extending in a general east-west direction, on the north flank of the Hatchetigbee Anticline. On September 1, 1947, there were 21 producers in the West, and 9 in the East Gilbertown area. No more drilling has been done in the West Gilbertown area, under lease to Hunt Oil Company. However, the East Gilbertown area has been the scene of great activity, which brought the number of producers from 9 to 21. At this writing 8 permits have been granted for additional wells, 3 to Carter Oil Company, 2 to Magnolia Petroleum Company, 1 to R. G. Houser, 1 to Robert Locke, and 1 to R. L. Lawrence. The area of proven production has been extended eastward, until it now spans about 4 miles.

In West Gilbertown, most of the wells produce about 50 barrels per day. In the East, a majority of the wells produce the allowable of 100 barrels per day. In the west, 13 wells produce from fractured zones in the Selma chalk Upper Cretaceous age, and 8 from the underlying Eutaw formation, also Upper Cretaceous. In the East, 1 well produces from both the Selma and Eutaw, while the rest have been finished off in the Eutaw. Chalk wells are about 2600 feet deep, while Eutaw wells range from 3200 to 3500 feet. In the Eutaw formation, about 6 petroliferous horizons have been encountered in about 200 feet of beds.

The oil is black, asphaltic base, and 17 to 20 gravity.

Up to now, all production has been sold to Hunt Oil Company, which operates a pipe line extending through the field to a terminal on the right bank of the Tombigbee River near old St. Stephens, whence it is shipped by barge to Tuscaloosa. There it enters a refinery operated by Placid Oil Company, a subsidiary of Hunt Oil Company, and is made into various asphalt products, with excess light hydrocarbons sent elsewhere for blending into gasoline, etc. Reported capacity of the refinery is 4000 barrels per day. The pipe line also takes oil from several wells just across the line in Mississippi.

Production from the Gilbertown field for April was 48,785 barrels, and it is likely to show a sharp increase in the next few months.

Varying amounts of salt water are produced along with oil in most of the wells. Single wells or clusters are served by separators, and the salt water is disposed of into Wilcox (Eocene) sands. The field has water drive, though a small amount of gas is present in a few of the wells in the East Gilbertown area.

Porosity in the Eutaw formation is about 32 percent and permeability averages 150 millidarcys.

McINTOSH SALT DOME. In 1949 the seismograph outlined and a core-drill outfit drilled into a shallow, piercement type salt dome near McIntosh, Washington County. At the point encountered by the drill, the salt core was 422 feet below the surface. Its discovery came as no surprise, for it had already been established that a deep salt basin existed in southwest Alabama. Inasmuch as no further work has been done, the diameter of the core and whether or not oil and/or gas is present must remain in doubt.

Prospects

In order to accurately appraise the oil and gas possibilities of Alabama, based upon data now at hand, the state may be divided into provinces (see map). These will be discussed in the order of their estimated importance.

1. In this area the Gilbertown field and new discovery in Clarke County are located, as well as the McIntosh salt dome. In 1945 the Boykin 1 in the northern part of Mobile County, just south of Calvert, strongly indicated the existence of a deep salt basin. Presence of the long and widely known and important geologic features, the Hatchetigbee Anticline and Jackson Fault, in this province, lent encouragement to much exploratory work, beginning more than 65 years ago. Even so, a period of approximately 60 years elapsed before Hunt Oil Company brought in Alabama's first commercial oil well in the Gilbertown field. Most of the wells drilled in the area, prior to 1944, were without shows of either oil or gas, notable exceptions being those drilled near Mobile and at Fort Morgan, on a narrow sand spit along the southern border of Mobile Bay, all of which had gas shows. Actually, not enough drilling has been done in the area to interpret accurately its subsurface conditions and to evaluate its potentialities.

Upon the surface of this region are formations from Eocene to Recent age. All of these beds extend southward in fairly uniform thickness and characteristics, as do all of the Upper Cretaceous formations, except the basal one, the

Slush pit, tanks, pumping jack, etc., on ramp built on swamp floor to avoid flood waters, at Marion Wall Davies 1 of Humble Oil & Refining Company, Southern Clarke County, Alabama.

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Tuscaloosa. Here the abnormalities begin, and become successively more complex downward. The few very deep wells have shown some basis for correlation with well known beds in Louisiana and Texas. Among prominent, heretofore unsuspected beds, are marine sections in the Lower Tuscaloosa formation, underlain by a considerable thickness of beds assigned to the Lower Cretaceous, which are not known to outcrop at the surface. In the Eutaw, Tuscaloosa, and underlying beds are many sand members which are ideal for oil or gas.

In this area was drilled Alabama's deepest well to date, Humble Oil & Refining Company's Jessie R. Williams 2, Washington County, which went to 15,659 feet, stopping in the Lower Cretaceous.

Known structures in the province, along with two productive areas, have led the writer to believe that this is the best area in the state to look for oil and gas. In addition to normal structures, such as anticlines, fault zones, and salt domes, there is a possibility of getting production from sand lenses along the outer margins of the province.

Early Gas Production

2. This province includes most of the Warrior Coal Basin and the area to the west and south where the Coal Measures plunge underneath the Upper Cretaceous beds. Structures are fairly common in this province. In addition to the Hamilton gas field, there was small production of gas in the Fayette gas field in 1912 to 1914. Almost every well drilled in the area reported shows of oil or gas or both, mostly in formations of Mississippian age.

Another important feature in this province is the series of three wells drilled by Glenn D. Rose on a structure between Manchester, Walker County, and Poplar Springs, Winston County. The first well encountered gas in Mississippian limestone, was acidized, and gauged 750,000 cubic feet of gas per day. The other two wells had good shows of gas, giving promise of commercial possibilities, and shows of oil, all in limestone. Rose abandoned the project in 1947, and nothing has been done there since. The writer considers it a favorable prospect.

Asphalt Beds

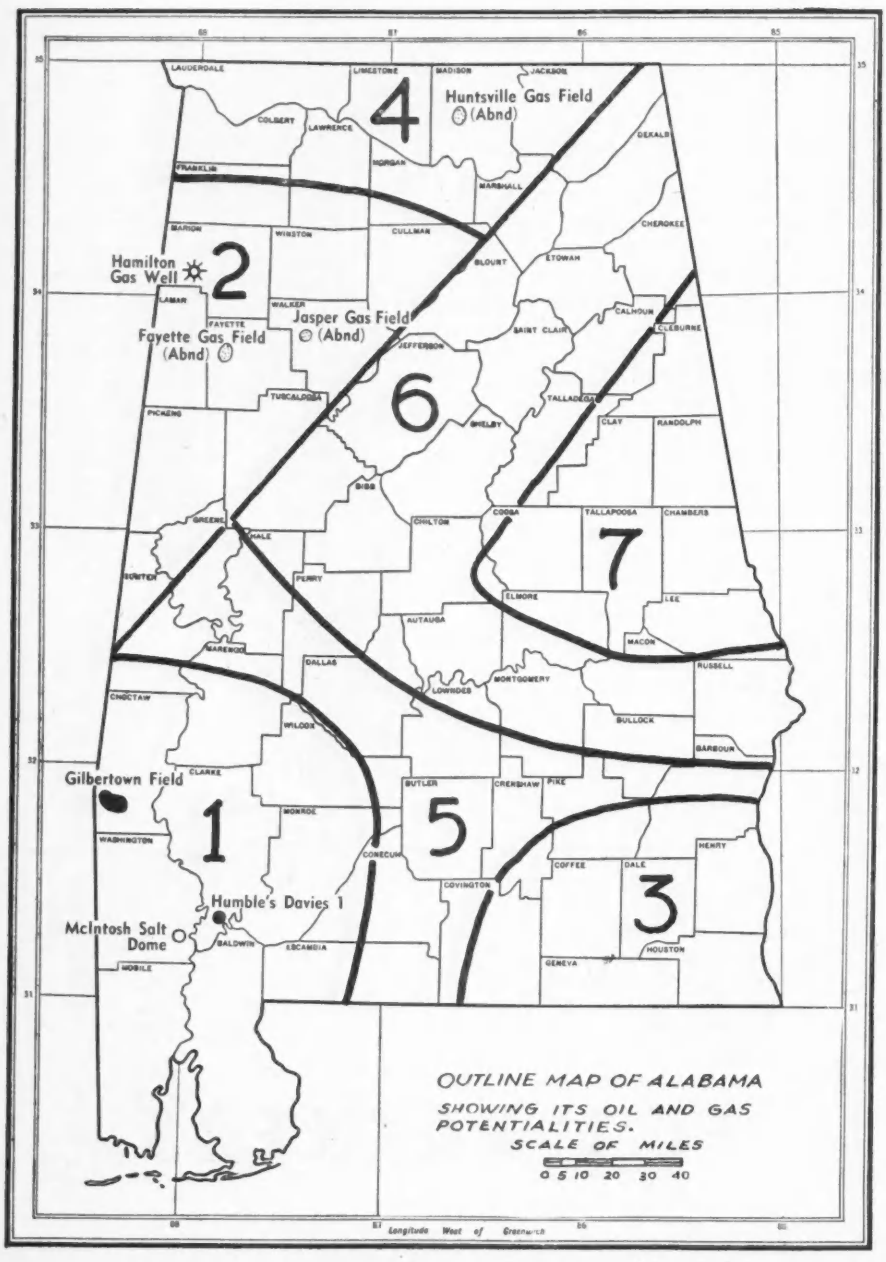
Another factor having an important bearing on the potentialities of this province is the existence of asphalt beds in the Hartselle sandstone and in the Gasper and Bethel formations, at their outcrops along the northern margin of the province. The asphalt is the residue left from evaporation of crude oil at the outcrop. It is reasonable to believe that some of the oil was trapped in structures to the south, and that oil fields will be developed from these horizons.

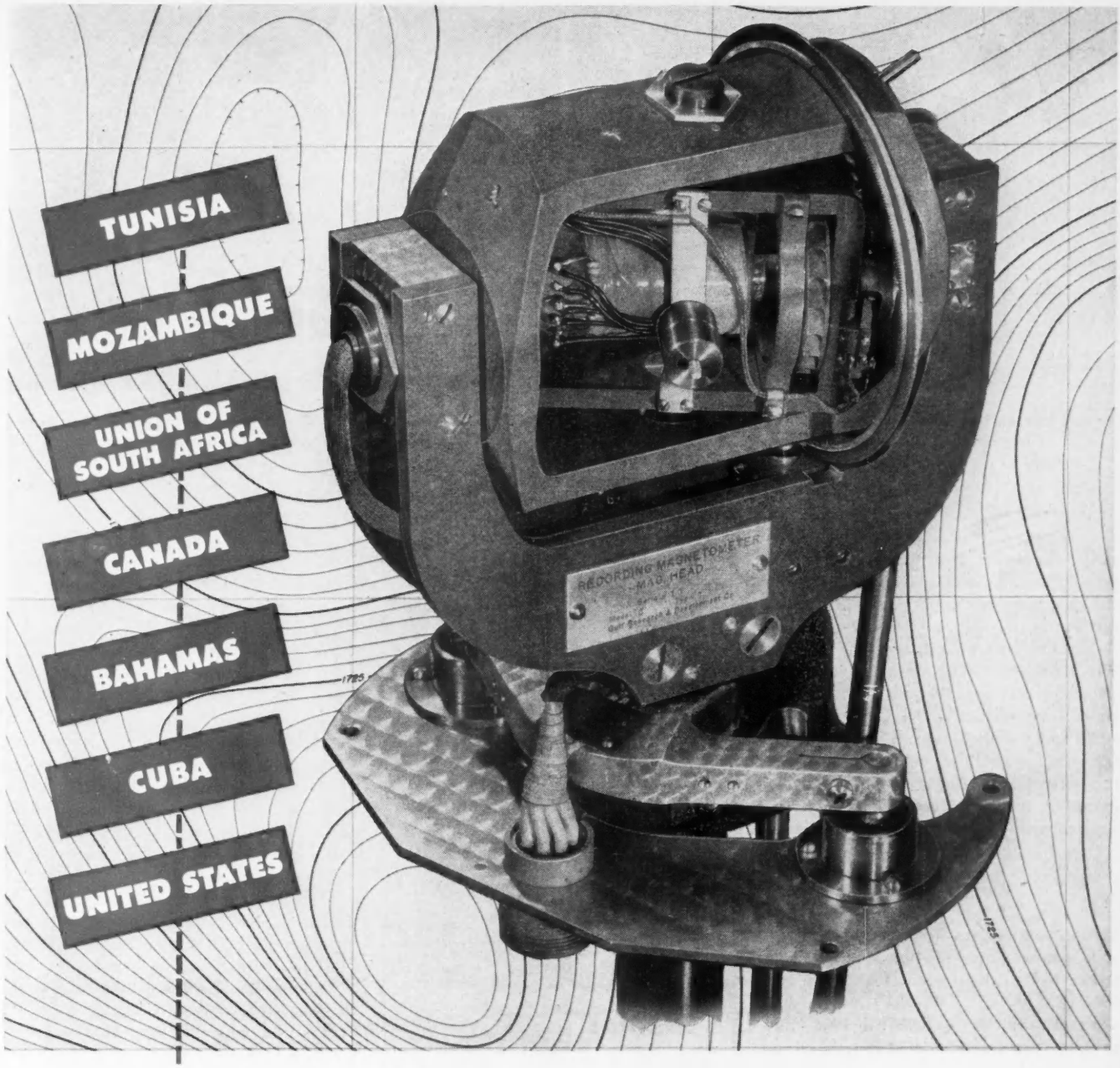
Elsewhere in the Appalachians, similar areas produce both oil and gas. For this reason, and for reasons given above, this is considered to be the second best area in the state to look for production.

3. The area outlined in Province 3 is not too well known. What information is available leads to a belief that the area contains a shallow salt basin, extending into adjacent parts of Georgia and Florida, and that oil might be found there. Outcropping in the area are beds of Eocene and Miocene age, covering beds of Upper Cretaceous age, which in turn rest on crystalline rocks of the basal complex. Whether or not beds of the Lower Cretaceous exist in the area cannot be known until a deep test is drilled. Even lacking adequate exploration, it is thought that future prospecting will justify its assignment to third place in potentialities.

4. This province includes most of the Tennessee Valley, where beds of Mississippian age outcrop over most of the area, with a few small patches of Silurian beds along the northern fringe. On the southern margin of the province are Coal Measures, which also cap mountain tops in the eastern part.

In 1865 two wells were drilled in Lawrence County to a supposed depth of 700 to 800 feet, the first to be drilled for oil in the state. It was reported that 1 well had oil shows. In 1890, Goyer 1 was drilled in the same county. At a depth of 1509 to 1529 feet, oil was reported to have risen 400 feet in the casing. Eight barrels were drawn out, and casing was ordered. Ultimately the





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Pumping jack on Humble's Marion Wall Davies 1, discovery well for a new field in southern Clarke County, Alabama.

Running test for gas on H. L. Cullet's A. Lewis 1, discovery well in the new Hamilton field, Marion County, Alabama.

casing arrived and was set. No oil showed up. The well was then shot with 100 quarts of nitroglycerin, which lifted the casing to the top of the derrick. Still there was no oil, and the project was abandoned. The oil recovered was green in color and 46 gravity. Recently, B. E. Davis drilled a well at or near the same spot, with shows only in the Hartselle, at a shallow depth. It is now thought that the Goyer 1, which had no casing in the hole, received its oil from the Hartselle, and not from lower beds.

Early Production

Also in this province, at West Huntsville, gas was produced on a small scale, from wells about 385 feet deep, in 1905-08.

Practically all wells drilled in this province have reported shows of oil or gas or both. The area does have possibilities, and is assigned to fourth place on its record.

5. This is a province of unknown possibilities. The northern part of the area comprises beds of Upper Cretaceous age, covering folded and faulted Paleozoics on the west and crystalline rocks on the east. It is likely that this part of the area has little actual chance of making a commercial field. However, the chances are much brighter in the lower part of Butler County, and in Conecuh, Covington, and Escambia counties. It is possible that this part of the area may rival Province 3 or even 2 in importance. It does have a sufficient thickness of cover. However, there has not been enough exploration to properly evaluate its position.

6. In this province are highly folded and sharply faulted Paleozoics, lightly covered along the southern margin by basal beds of the Tuscaloosa formation on the west, and thinly blanketed crystallines on the east. While oil and gas may occur here in commercial quantity, the chances are not very bright.

7. This is the area of crystalline rocks, in which neither oil nor gas would be expected to occur.

About the Author

DR. WALTER B. JONES, Alabama State Geologist and State Oil and Gas Supervisor, received his B.A. and M.A. degrees from the University of Alabama, and his Ph.D. degree from Johns Hopkins University. He has served as state geologist since 1927 and is the third to occupy the post in the 102 years since the Geological Survey of Alabama was established. Dr. Jones is a veteran of both World Wars, a colonel in the reserves, Corps of Engineers, and a prolific contributor to current technical publications as well as an author of books on geology.

State publications that are especially important to oil seekers and which can be obtained from the State Geologist, University, Alabama, are as follows:

Special Report 14—Geology of Alabama; by George I. Adams, Charles Butts, L. W. Stephenson, and C. W. Cooke. (In cooperation with the U. S. Geological Survey.) 312 pp. folded revised geological map of Alabama in pocket. 97 plates. 1926. In cloth, price $1.75 postpaid. Separate maps, folded and in stout manila envelope, $1.06 postpaid. Same, mounted on linen, $2.10 postpaid.

Special Report 15—Oil and Gas in Alabama; by D. R. Semmes, 400 pp. Maps and illustrations. 1929. In cloth, $1.25 postpaid.

Bulletin 10—Reconnaissance report on the Fayette gas field, Alabama; by M. J. Munn. (In cooperation with the U. S. Geological Survey.) 60 pp. Outline map, folded chart of sections, and folded colored geological map. Oct., 1911. 50 cents postpaid.

Bulletin 43—Magnetic investigations in Southwest Alabama; by J. Brian Eby and E. G. Nicar: with annotated well logs by Winnie McGlamery, 41 pp. 1 large folded map. June, 1936. 55 cents postpaid.

Bulletin 50—Well logs of Alabama; by Edgar Bowles. 357 pp. Map. 1941. Postage 12 cents.

Bulletin 57—Well logs of Alabama; by Lyman Toulmin. 177 pp. Map. 1945. Postage 10 cents.

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Internal Structure of Shoestring Sands

By OREN F. EVANS

Professor of Geology, University of Oklahoma

IN THE development of an oil field having a sandstone reservoir, when the producing area shows a narrow, elongated pattern, it is usual to speak of it as a "shoestring sand." There are many reasons, other than original deposition of sediments, why an oil field may show such a form. But it has been customary for geologists, especially since the work of Bass and others on the shoestring sands of Kansas and Oklahoma, to explain such long narrow fields as due to a form of a buried bar or spit and to assume that the future development of the field will follow a pattern determined by the usual shape of such deposits.

So far, geologists have given comparatively little attention to the internal structure of shoestring sands. This is partly because of the difficulty of obtaining oriented cores and partly because of a lack of knowledge of their internal arrangement. However, it was largely because of differences in amount of cross-bedding that Bass assigned an origin to the Verdan sandstone different from that of the shoestring sands of Kansas and Oklahoma. But here the differentiation was easily made, since the beds of the Kansas and Oklahoma deposits are mostly horizontal, while the Verdan sandstone lies exposed to the surface and its extensive cross-bedding is easily observed.

Although, in the study of shoestring sands, bars and barrier beaches have received the most attention, there are several other types of deposits that have a drawn out, slender shape and that, when buried and consolidated, may act as oil reservoirs. Among those that occur on or near beaches, are beach ridges, subaqueous dunes, balls, and channel deposits. Others, not so closely related to shorelines, are river channels, sand dunes, and certain sand ridges like those recently described in waters of intermediate depth in the English Channel and the North Sea. In some of these, the mode of formation has been known for only a short time, and in some the internal structure has never been observed directly and can only be inferred from what is known of the process involved in their building. Yet, in most cases, enough is known to be of considerable value to geologists in determining the extent and possibilities of a new field.

Beach Ridge

The beach ridge is an outstanding feature of many shore deposits. It is formed just above the shoreline by the work of the swash and backwash wherever there is an abundance of sand and gravel. Its size depends on the energy of the waves and the kind and amount of sediments available. Beach ridges often reach a height of several feet and, when buried and consolidated, might serve as reservoirs for oil. The material in a beach ridge usually is sand, although along some shores, where the wave action is heavy and large quantities of coarse material are present, it may be made up almost entirely of boulders and gravel.

The structure of a beach ridge is complicated. Its steeper slope is usually toward the water, and since it is the result of the adjustment that is always going on between the waves and the shore sediments, changes are continually tak-

SHOESTRING SANDS, yielding oil in narrow, elongated productive areas, may be better understood through study of their varying form and internal structure. Among the shoestring sands, bars and barrier beaches or offshore bars have received much attention, but there are also various other types of deposits of drawn out, slender shape that act as oil reservoirs. Having occurred on or close to beaches are beach ridges, subaqueous dunes, balls, and channel deposits. Others not so closely related to shorelines are river channels, sand dunes, and sand ridges. Enough is known about most of these deposits to be of considerable value to geologists in determining the extent and possibilities of a new field.

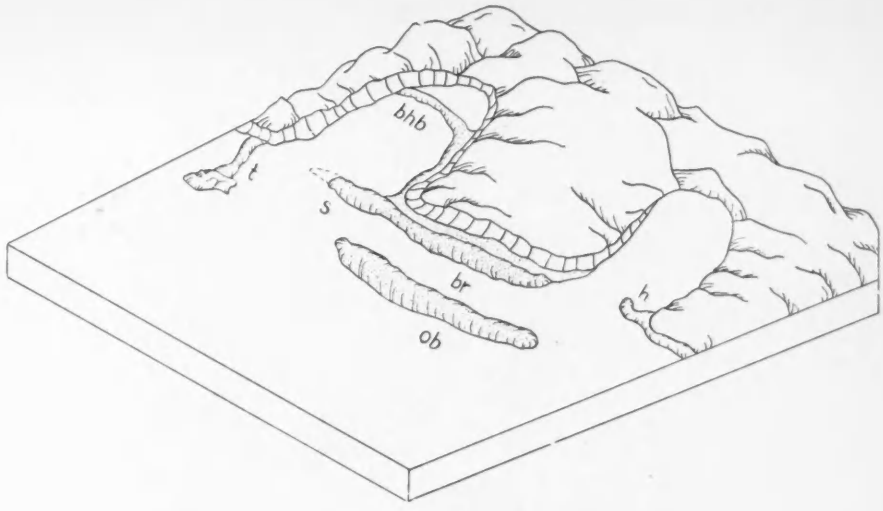
ing place in it as the waves vary in their size and intensity. In its general structure, it is made up of a large number of relatively thin overlapping sand lenses of various sizes, with their greatest thickness toward the axis of the ridge. Each time a wave breaks against the shore, sediment is carried up the face of the ridge by the swash. A part of this is deposited and a part is returned down the slope in the backwash. Since the waves that reach the shore are not all of equal size, some throw the swash to a greater height than others and often the water of a wave overtops the crest of the ridge and flows down on the other side. This broadens the ridge, and if the carry-over occurs repeatedly, it results in the formation of a series of small deltas on its landward side.

While these somewhat complicated processes are taking place, a rapid sorting action of the sediment is also going on. Since the velocity of the water in the swash and backwash is less toward the crest of the ridge, the sediment laid down there is finer than that deposited farther down the slope, and that carried over to the landward side is still finer than that laid down near the crest. Since, during each storm, there is considerable variation in the strength of the swash, and the storms also vary in intensity, it follows that a beach ridge is extremely complicated in the arrangement of its lenses and deltas.

Dip or Beds

From the general arrangement of the sediments in a beach ridge, it is evident that a core taken from its seaward side should contain coarser material than one taken from the landward side. Also, the beds will dip seaward and landward each way from the axis of the ridge, and on the landward side there will be evidence of occasional small delta structures. The upper surface of the ridge on its seaward side will have a slope varying from 3 or 4 degrees to as much as 15 degrees. The landward slope is considerably less, and if the ridge is built on the face of an already sloping beach, may be almost flat. Most of the beach ridges are built on a surface already covered with a layer of sand and gravel, and this may also be a part of the oil reservoir. Since the material in this layer has usually been worked over by the waves, any dip in its beds will usually be in a direction perpendicular to the shoreline. Other beach structures somewhat related in their method of formation to that of beach ridges are spits, bars, tombolos and, probably, barrier beaches.

A spit is a ridge or embankment of sediment attached to the land at one end and terminating in open water at the other. It is younger than the land to which it is attached, and its crest from the land outward for some distance rises above the water.



Shoreline showing beach features.

h—hook. s—spit. br—beach ridge. bhb—bay-head bar. ob—Offshore bar. t—tombolo.

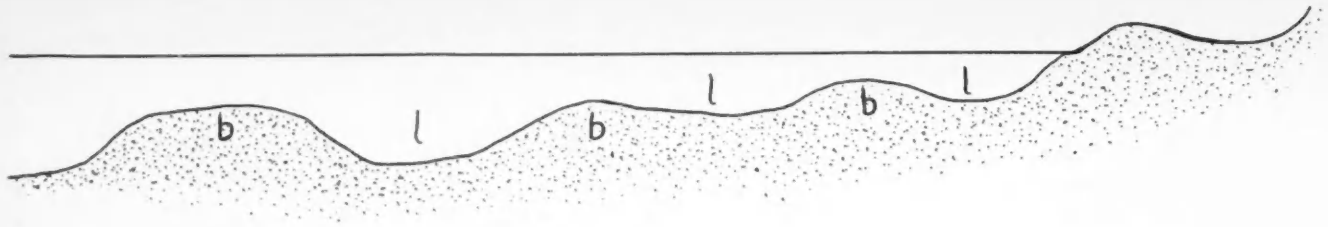
A bar is a spit that has been extended so as to enclose, or nearly enclose, a portion of the water body into which it extends. It may be built entirely from one end, or it may be the result of two spits building from opposite directions.

From the above definitions, it is evident that the same processes are active in the building of both spits and bars and that the two are alike in their internal structure. Each is composed of two parts; a lower portion made up of material laid down beneath the surface of the water, usually in the form of a ridge, and an upper part that extends above the water surface. This upper part is an extension of the beach ridge and has essentially the same internal structure. Spits and bars are of all sizes from a few feet to several miles long. Many of the smaller ones are merely beach ridges extended out into shallow water. But the larger ones, built out into deep water, are made up of a submerged ridge and the extended spit lying on top of it.

Most geological textbooks, in discussing the formation of spits and bars, explain the part beneath the water as built by material carried by the shore current and deposited by it as it passes from the shallow to deeper water. But the building of the structure above the water surface is either left to the imagination or limited to a general statement that it is the result of wave work. In this, the authors are merely following Gilbert's discussion of the fossil spits and bars of Lake Bonneville, where he likens their building by the shore current to the way a railway embankment was constructed, in his time, with its regular crossbedding. But later investigations have shown that the building of spits and bars is not nearly so simple a process as this implies.

Simultaneous Processes

Although separate processes are involved in the building of the upper and lower parts of a spit, the two go on almost simultaneously, the extension of the beach ridge following closely on the construction of the submerged ridge. In deep water, the submerged part is usually deposited by a shore current, but the upper part is the result of the extension of the beach ridge by beach drifting and the effects of wave refraction. When waves meet the shore at an acute angle, the water in the resulting swash and backwash describes a curve that has the shape of a somewhat deformed parabola. As a result, the sediment in the seaward face of the ridge is moved along the shore in large quantities. An appreciable part of the material in the submerged portion of a spit and nearly all that above the water is brought to it in this way. Also, as the waves traveling along the face of the beach ridge reach the outer end of the spit, they refract around it and produce a swash and backwash that carries material across its end and so widens it. Thus the width of a spit depends on the angle at which the waves reach the shore, the depth of the water where the spit goes beneath the surface, and the amount of sediment available as compared with the transporting power of the waves. If the wind always blew steadily from the same direction a spit



Section through low and ball.

b—ball. l—low.

would everywhere have the same internal structure with a regularly crossbedded base carrying a beach ridge structure above it. But, outside the equatorial zone, the wind usually varies widely in direction as well as intensity, and as the wind changes direction so do the waves and shore currents.

Hook Formations

All this brings numerous complications into the building of both the upper and lower parts of spits and bars. One easily observed effect is to sometimes change the direction of the axis of the spit at its outer end and cause the formation of a hook. If the wind, which has been blowing toward the outer end of the spit at an acute angle with the shore, gradually changes its direction so as to be more nearly perpendicular to the axis of the structure, the rate of beach drifting decreases and the effect of wave refraction increases. This causes a large part of the sediment in transportation to be carried around and deposited across the end of the spit.

Along sea coasts, this process of hook formation is often aided by the action of tidal currents, which sometimes move through the inlets with considerable velocity, but in tideless waters wave refraction is always the dominant process. Since the more effective wave action is always from the direction of the open sea rather than from the relatively smaller enclosed bay, hooks nearly always point landward rather than seaward.

Nearly all large harbors formed by enclosing spits, like those at Erie, Pa., and Toronto, Canada, show repeated hook formation. At the same time that the refracted waves are building the hook, they are also breaking against the submerged ridge at the end of the spit, disturbing the sediments in it and so causing considerable redeposition.

Thus, if it is suspected that the reservoir sand may be a spit or bar, look for a beach ridge structure in the upper part that is occasionally modified by the processes of hook formation. Then, as this upper part is passed through by the drill and the lower ridge penetrated, look for some crossbedding, dipping toward the direction of its submerged end but occasionally changing toward the land. These crossbedded layers will probably be separated by numerous horizontal beds of varying thickness.

Spits, bars, and barrier beaches are probably the three structures most often considered as being the cause of shoestring sands. A barrier beach is a ridge or embankment of sediment lying approximately parallel to the shoreline and reaching above the surface of the water. It is not attached to the shore at either end. Barrier beaches, sometimes also called offshore bars, occur in relatively shallow water on gently sloping bottoms. A good idea of their size and extent can be obtained by examining the maps of the Texas and Carolina coasts. Some of them, as along the Texas coast, are 100 miles or more long. They are typically large features and differ from spits and bars in that they seldom or never occur as small structures. The smallest of them are at least several hundred feet long.

The origin of offshore bars has been widely discussed, but as yet, there is no general agreement on the subject. The theory usually given in the textbooks, and rather widely accepted in the absence of a better explanation, is that they are built up from the bottom and brought above the water surface by the forward plunge of the waves in the breaker zone. But recently it has been proved that plunging breakers move sediment slightly away from shore rather than toward it and that it is impossible for a ridge to be brought above the water surface by the work of the breakers alone.

Thus, because of a lack of knowledge of how an offshore bar is formed, it is difficult to describe its internal structure with certainty. An explanation that seems probable is that they are large spits, built in shallow water under conditions especially favorable to their preservation and growth. Their large size may be the result of lengthening by beach drifting and littoral currents, and since the bottom on which they rest is usually above the curve of equilibrium, they are often widened by additions to their seaward sides through the action of waves of translation, subaqueous dunes, and shoreward moving sand ripples. This is somewhat indicated by aerial photographs of some barrier beaches which show they have been widened by a succession of beach ridges added to their seaward sides. As is to be expected, many of them carry considerable areas of sand dunes. Thus their general structure probably resembles that of a very large spit or bar except that a succession of drill holes might discover a series of parellel beach ridges in the upper part while the lower part, especially on the side toward the sea, would have little crossbedding since it is the result of deposition accompanying a prograding shore.

Ball Types

Another type of ridge that lies parallel with the shoreline is the ball. Along with their accompanying lows, or troughs, balls occur in series along shores that have an abundance of sand. Some of them rise as much as 6 or 8 feet above the bottom and are 100 to 300 feet wide. They are formed by the plunging breakers. When the water along the front of a plunging breaker hits the bottom, it digs a trough and moves the sediment from it slightly outward and deposits it in a ridge on the offshore side. Balls contain little or no crossbedding and, of course, carry no beach ridge or sand dune structure on their tops. In drilling, they should be relatively easy to identify because of their shape and arrangement. When buried, the upper contact should appear as a series of structural troughs and ridges. They increase in size with distance offshore, are from 100 to 400 feet apart, and run parallel with the shore for long distances. Occasionally the ball nearest the shore may show some crossbedding on its shoreward side. This is because, in times of low water level, tne waves of translation may start a subaqueous dune movement across it.

Under certain conditions, balls may serve as the foundation for spits and bars. Thus, some bay-head and mid-bay bars probably had their beginnings in a series of lows and balls formed on the

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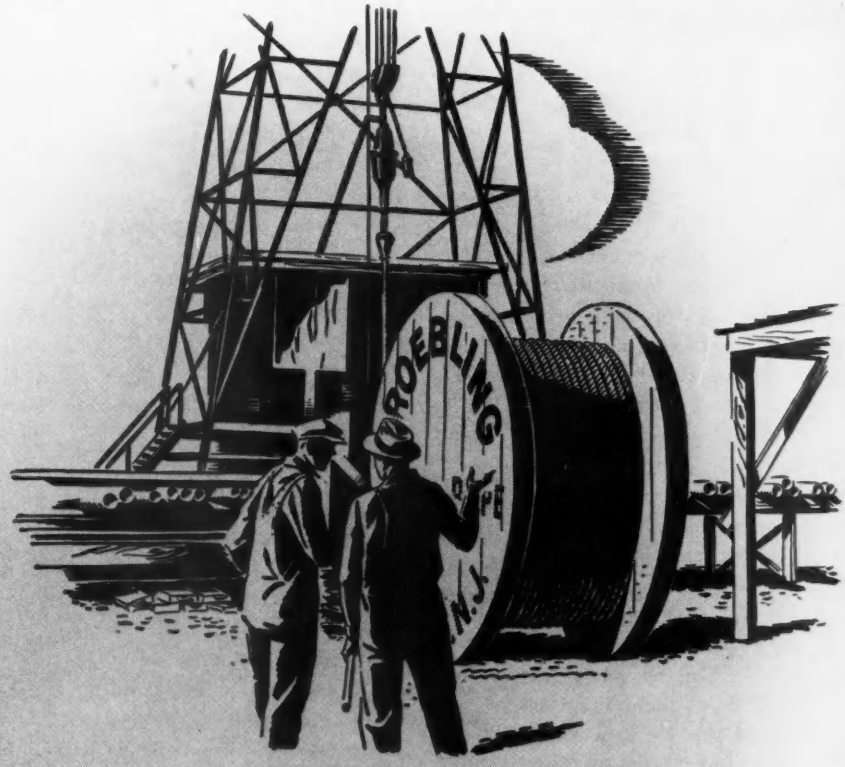

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bottom of a sandy bay by the incoming storm waves. Later, sediment in the form of a beach ridge was moved out from the sides of the bay along the axis of a favorably situated ball. It is possible that the great bar that protects the harbor of Duluth at the head of Lake Superior may have originated in this way.

Subaqueous dunes are submerged sand ridges that are in the process of being moved forward by the waves and currents in much the same way that a sand dune is advanced by the wind. They may originate at the submerged ends of spits or large cusps or, occasionally, from balls as a result of the rapid lowering of the water surface. Since their forward movement is caused by the sands being carried over their tops and deposited on their lee sides by waves of translation and the forward movement of asymmetrical sand ripples, they are completely crossbedded, with the beds dipping toward the old nearby shoreline. Many subaqueous dunes are of ample size for oil reservoirs. Some are as much as 15 or 20 feet thick and 200 or 300 feet wide. On the side from which the waves come, their slope is very gentle, but on the lee side their sediments lie at the angle of repose, usually about 30 degrees. Since their forward movement does not disturb the bottom, they often lie on a ripple marked surface. This, along with their shape and complete crossbedding, makes them easy to identify.

Channel Sands

Elongated deposits of another type that may sometimes act as oil reservoirs are channel sands. These are laid down in narrow straits at the entrance to bays or inland seas or in the passage between an island and the mainland. The transporting agents are tidal currents aided by differences in temperature and salinity, and under favorable conditions may sometimes reach velocities up to 15 or 20 miles per hour. In some places the movement may be all in one direction, merely varying in velocity; in others the direction of movement changes with the ebb and flow of the tide.

Because of the strong transporting currents, channel sands are often extensively crossbedded, with the direction of dip approximately parallel with the direction of movement of the current. These crossbedded layers are from a few inches to several feet thick and are usually separated by horizontal layers of silt laid down during the slackening of the current at the change of the tide. Both current-formed and wave-formed ripple marks are common, but of course will show up only occasionally in drill cores. The current-formed ripples lie with their longitudinal axes perpendicular to the shorelines, but the wave-formed ripples are usually at right angles to this because of the local onshore winds and the effects of wave refraction. Giant ripples, up to several feet wide, may also be present. These are probably formed by the currents that accompany the ebb and flow of the tide and may be either symmetrical or asymmetrical in shape.

Verdan Sandstone

The Verdan sandstone of Oklahoma is the best known example of what is probably a channel sandstone. It is exposed on the surface as a broken sand ridge, 10 to 15 feet thick and several hundred feet wide, that can be followed on the present surface for more than 50 miles. It is composed of a series of beds from a few inches to more than 2 feet thick, that are persistently crossbedded toward the northwest and are separated in many places by layers of horizontally laminated sandy shale. Of course, a deposit as large as the Verdan might show on an oil map only as a series of small fields, with a linear arrangement, and never be recognized as a true shoestring sand.

Deposits of another type about which, as yet, comparatively little is known, are the irregular masses of sand that lie on the bottom along some coasts in moderately deep water a little distance offshore. Some of these, called flying bars, have been described along the shores of Nova Scotia and New England. They are the remains of small islands that have been destroyed by the waves and currents and the sediments distributed to leeward on the bottom in the form of elongated ridges. Their mode of formation is somewhat like that of the ridges that form the lower part of large spits and bars, and it is safe to assume that their internal structure is much the same.

Other similarly located sand masses are known to be present in the English Channel and the North Sea. Some of these are as much as 25 feet high and 600 feet wide. Others, of smaller size, have been found that are arranged in series over considerable areas. Not much is known of their origin, but it is thought they may be the result of strong alternating tidal currents. If so, they should contain considerable crossbedding in a direction at right angles to their axes.

Compared with those of the sea, the number of terrestrial deposits capable of acting as shoestring reservoirs is small. They are not only fewer in number originally but, from the nature of the case, are more subject to destruction by an advancing sea than are the ridges that are already partly or completely submerged by the sea when first formed. Certain glacial deposits, such as eskers and valley trains, are long and slender in shape but, so far as known, these have never held their form and identity long enough to become reservoirs for oil. However, in a few cases, reservoir rocks have been identified as fossil sand dunes. This is understandable from the nature of sand dunes, which because of their high permeability are very resistant to erosion from precipitation, and although easily attacked by waves and currents, much of their internal structure would be retained if they were submerged in quiet water.

River Beds

The most important terrestrial deposit of shoestring character is the river bed. The reservoir sands of several fields are believed to have this origin. As with sand dunes, the structure of river beds is too well known to merit much description. Their outstanding characteristics are the heterogeneous nature of the deposits, the erratic crossbedding, and the presence of numerous current-formed sand ripples. These are likely to vary greatly in direction in the successive beds of the deposit, especially for rivers of the type of the Platte and the Canadian with their broad sandy bottoms and sudden changes of volume. This is because of the numerous curves of the stream over its flat bottom and the fact that meanders of a river migrate downstream, thus causing the direction of flow, over a period of time, to be toward nearly every point of the compass.

In interpreting oil reservoirs from drill hole records it must always be kept in mind that the pattern of an oil field may be accounted for in many ways besides original deposition; also that determination of subsurface structures from cores is difficult and subject to many uncertainties. Thus extreme caution is necessary, and the final decision as to the nature of the reservoir should be deferred until sufficient observations are available to justify a decision.

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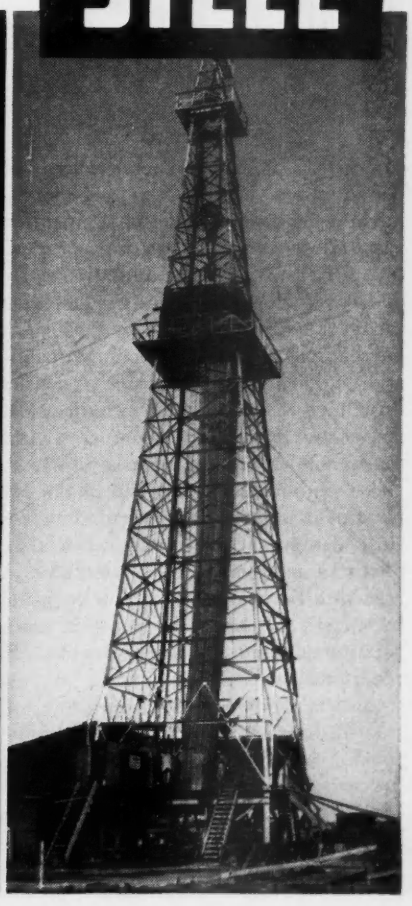

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Above Right: Rig 17 shown here reached 10,624 feet after 152 days of continuous operations. J&L Drilling line on this rig has made more than 150 round trips and is still in good condition.

Above Left: Going back in after drill stem testing distillate on Arrow Drilling Co. Rig 17 in Lindsay Field, Garvin County, Oklahoma. In the foreground are Engineer S. E. Hudson, and Crewmen W. E. Hites and K. W. Keenan. Supervising are Tool Pusher L. E. "Mac" McConnell (left), and Driller W. W. "Woody" Moore. Derrickman (not shown) is Ray Satterwhite.

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Electronics

Applied to Oil Exploration

By B. M. BALTER
Electro Graphic Survey Company
Longview, Texas

WHILE the gravitimeter, magnetometer, torsion balance and seismograph have become established as conventional exploration tools in locating structures favorable for the accumulation of oil and gas, laboratory and field experiments have been carried on for a period of years to determine the practicability and efficiency of applying electronic principles to determine the hydrocarbon content of favorable structures with a reasonable degree of accuracy.

A technique being applied in the Mid-Continent area is supplemented by physical equipment consisting of a truck-mounted self-contained power unit and recording instruments. The theory upon which the technique is based is the insulating quality of hydrocarbons. The recording instruments create an electronic field which insulated bodies distort in direct proportion to the depth of those bodies and the percentage of hydrocarbons in those bodies. Observed results are the measurements, expressed in "voltrons," of that distortion. While there is a certain amount of distortion due to insulators other than hydrocarbons, it has been found that the voltronic readings of hydrocarbons as compared to voltronic readings of other distorting elements are sufficiently dissimilar to be recognized as such by the engineers in charge of the recording instruments. (The word "voltron" was coined and represents an electrographic unit of measurement.)

The time element involved in making the survey varies with the topography of the area, accessibility being as essential an element in this type of survey as it is in all other types. Once the station is reached, the time necessary in taking a recording of the reading varies with the length of time necessary for the instruments to attain an equilibrium. As a rule, an average of 20 readings each working day is obtained. In correlating and translating all the field work it ordinarily takes one day of office work for each two days of field work.

In surveying an area, the general procedure is to set the stations at half-mile intervals running north and south, and the same intervals running east and west, encompassing an additional area of two to three miles beyond the critical area.

Primary readings are then returned to the engineering office, where they are correlated and translated into value lines which resemble structural contours on a structural map. The figures on each one of the lines do not represent subsurface depths but rather hydrocarbon values. The lines showing the highest values do not necessarily show the high of a structure, yet these two features may at times coincide.

The primary survey is then studied and analyzed, after which it is determined whether closer detailing is indicated on the area as a whole or on any particular portion of the area.

If closer detailing is required, then readings are taken at 440-yard to 200-foot spacing, depending on whether value lines must be closed or indications of a faulting are to be confirmed.

After the secondary survey is completed, the same office procedure is followed as with the primary survey. All information from both surveys is correlated and translated, and a report is drawn of the findings. The finished map and report require no interpretation on the part of the reader as values speak for themselves; the higher the value the lower the risk, and the lower the value the higher the risk.

Tests made in Ouachita County, Arkansas, and Wood County, Texas, both highly faulted areas, resulted in defining faults with production on only one side, whereas a like survey in an area producing from both sides of a fault shows only a commercial hydrocarbon value without indicating a fault.

It has been found from exhaustive tests in the field that the norm, or minimum commercial value, varies with the area and the horizon from which production is obtained. To illustrate that point, a norm of 100 points of value on the Pettit lime in the Woodlawn field of Harrison County, Texas, will show for a dry hole; the same 100 points of value on East Texas Woodbine sand shows for a very good producer.

A cross-section test of the Woodbine field in East Texas resulted in the interesting fact that in a sand body abandoned due to water encroachment, the hydrocarbon values still registered as of commercial potential, although showing a lesser value than the same sand thickness above the water line.

It has been noted that a greater degree of accuracy is obtained wherever there is an established basis for comparison. To fix a norm for any area, one well must be drilled on the area surveyed or in a contiguous area.

Wherever one well has been drilled, a reading is taken of a known quantity, and that reading becomes a fixed value for that particular quantity. By computation, with these two known factors, the norm for that particular area can then be established. A survey can then be made of that whole area with all the consequent readings being made on a comparative basis with that initial known quantity, with the result that a truer and more reasonably accurate picture can be given of that area.

A portion of a major oil company block was surveyed east of Woodlawn, Harrison County, Texas, as shown in Figure 1. The area covered by the survey included four completed wells and five outpost locations which have since been drilled and completed. The wells on Units 5, 6, 7, and 11, in areas showing 150 values or over made good commercial producers, while the well on Unit 8 located at a point with a value of 145 will at best make a very weak well as compared with wells drilled on locations with values of 150 or over.

Surveys made in areas producing from lime horizons show higher values than those shown from sand bodies.

The norm, or minimum commercial value, may read 100 in one area and 50 in another area, but they both equal zero so far as hydrocarbons in commercial quantities are concerned. It will be noted in Figure 1 that the extreme northeast reading drops to 14. At no point did the readings go down to absolute zero. This can be accounted for by assuming that there are enough hydrocarbons in that whole general area to

permeate the soil in sufficient, although minute quantities to be recorded.

A survey made in Smith County, Texas (Figure 2), showed values on a certain lease which ordinarily would be interpreted as being of commercial potential. Upon drilling to the predetermined depth, a very thin, saturated section of hard, limey sand was found which was not of commercial value. This can be accounted for by the fact that the lime content offered such resistance that the reading at the surface was higher than the actual hydrocarbon content warranted, and was therefore misleading. The test was abandoned as dry.

It has been noted that the above mentioned survey, together with others with like results, show that in many instances the readings at the surface are cumulative in effect rather than specific. This is true in many areas where a number of thin non-commercial saturated horizons are encountered.

It has been noted that surveys of oil bearing structures coincide generally with the thinning and the thickening of the structures. In some cases they will show a higher value where later development shows a thinning of the section. Reason for this is because there was a greater degree of saturation in that thinner section than at another point where the readings were lower and the section was thicker, though with a lesser degree of saturation.

Surveys made in Louisiana on known dome-like structures have, as a rule, shown the highest values on the flanks of the structure, indicating that surveys show only the most logical spot to drill rather than the high of a structure.

In surveying areas over known structures, the survey shows only the rise and fall in hydrocarbon values, without necessarily showing the true picture of the structure itself. Since it has been found that the norm varies with the area and horizon, it is obvious that in drilling a wildcat in any area, the most logical initial location would be at a point showing the highest value. For the same reason (variation of the norm), it would be difficult to determine whether a commercial producer would be made without a basis of comparison. In the case of wildcat exploration, therefore, it would still be the drill bit only that would determine whether production could be obtained.

Although a reasonable degree of accuracy in making commercial producers has been attained by the application of this type of electronic technique, careful studies were conducted of all the data accumulated to date to determine the possibility of increasing the percentage of accuracy. The following conclusions were drawn: structure and hydrocarbon value on the map may coincide at times. Water in the oil sand cannot be determined with any reasonable degree of accuracy from surface recordings. Average norms have been computed from a number of surveys, and they show that down to 4500 feet, the norm is approximately 50 points of value, from 4500 to 6000 feet approximately 75 points of value, and from 6000 to 9500 feet approximately 100 points of value.

Since the norms are all approximate and may vary 20 percent, plus or minus, it has been found that the highest degree of accuracy in mapping the hyrocarbon values of any given area is obtained after one well has been drilled, regardless of whether it has been completed as a commercial producer or a dry hole. Wherever one well has been drilled, and a reading taken of a known quantity, that reading becomes a fixed value for that particular quantity. By computation, with these two known quantities, the norm for that particular area can then be established. A survey can then be made of the entire area, with all consequent readings on a comparative basis with that initial known quantity, with result that a truer and more reasonably accurate picture can be given of that particular area.

The two most important questions confronting the driller after completing the first well on a wildcat block are first, which direction to drill the confirmation well; and second, how to define the limits of productivity. These can both be answered with reasonable accuracy by this technique.

In conclusion, it has been found that the technique does not and cannot usurp the functions of the geologist, nor any of the other methods of locating structure, but rather is another tool for use in conjunction with conventional methods to diminish the risks constantly facing those in search for oil.

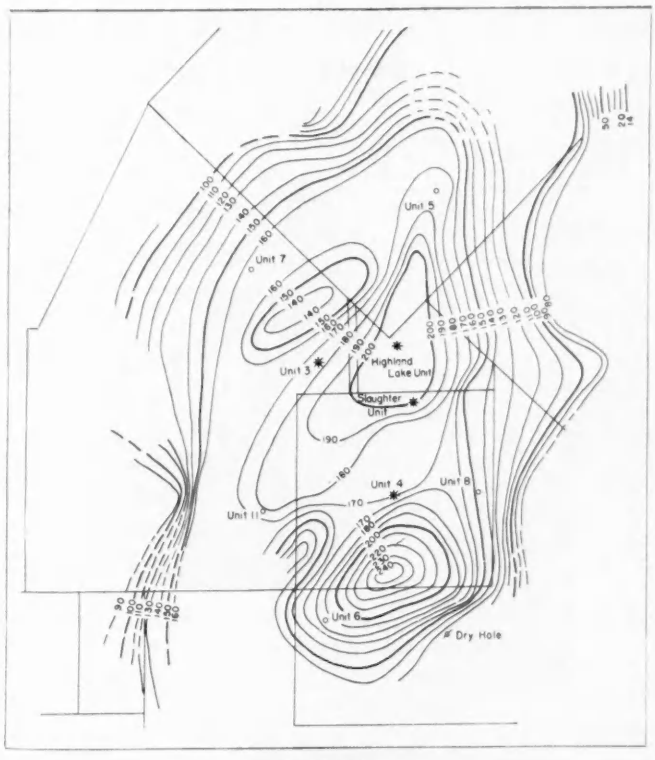


FIGURE 1
✳ Producing Wells Jan. 15
○ Loc. or drilling wells Jan. 15
~ 10 Voltrons Interval

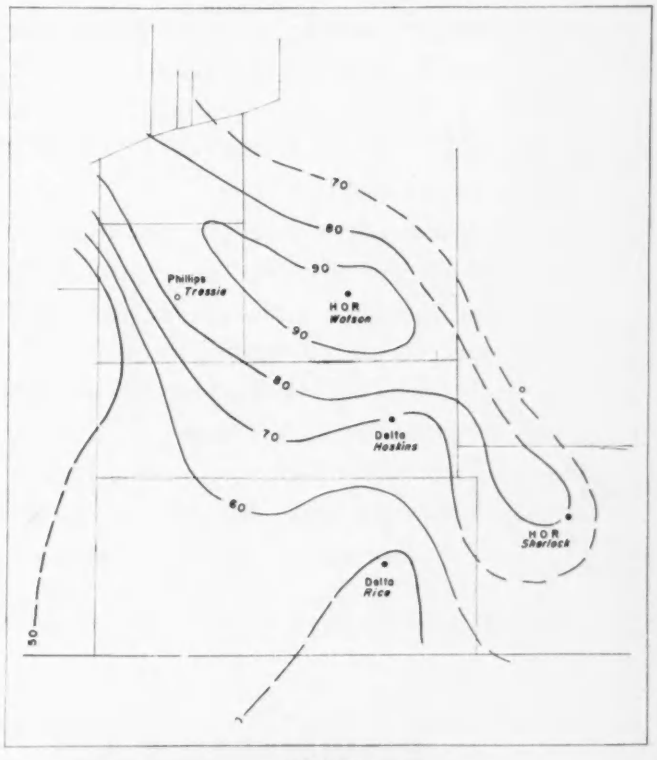
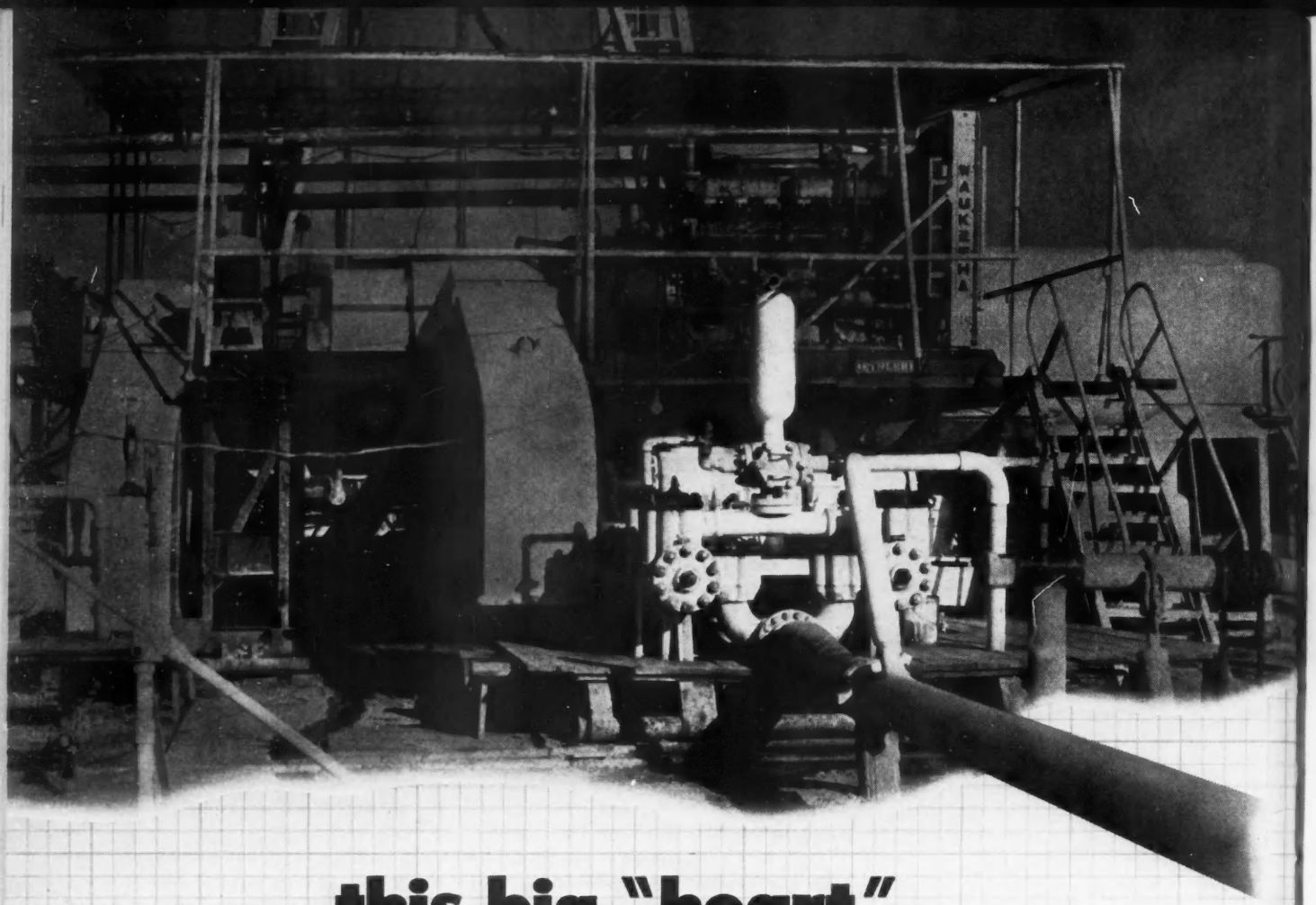


FIGURE 2
● Producing Wells Feb. 18
○ Loc. or drilling wells Feb. 18
~ 10 Voltrons Interval



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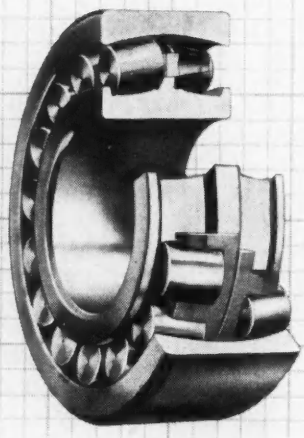

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Exploration

In May Tops Previous Records

A NEW all-time high mark of 734 exploratory well completions were made in May to top the previous monthly record of 682 finaled in June, 1949. This surge in exploratory drilling boosted the year's total wells to 3147, an increase of 7.7 percent over the 2922 recorded in the first 5 months of 1949, the most active year in history.

A better-than-average percentage of the month's wells proved to be successful, but the total was not a new record. Producers totaled 151 for a score of 20.6 percent of total wells, while the all-time high of successful wells remained at 163 and credited to June, 1949.

The month's discoveries included 101 new oil pools, 72 new fields and 29 new pay horizons. Also included were 4 new distillate fields and 14 gas pools. The gas discoveries were made up of 13 new fields and 1 new pay.

Major extensions to existing fields were made by 32 wells during the month and 28 of those were in oil producing areas.

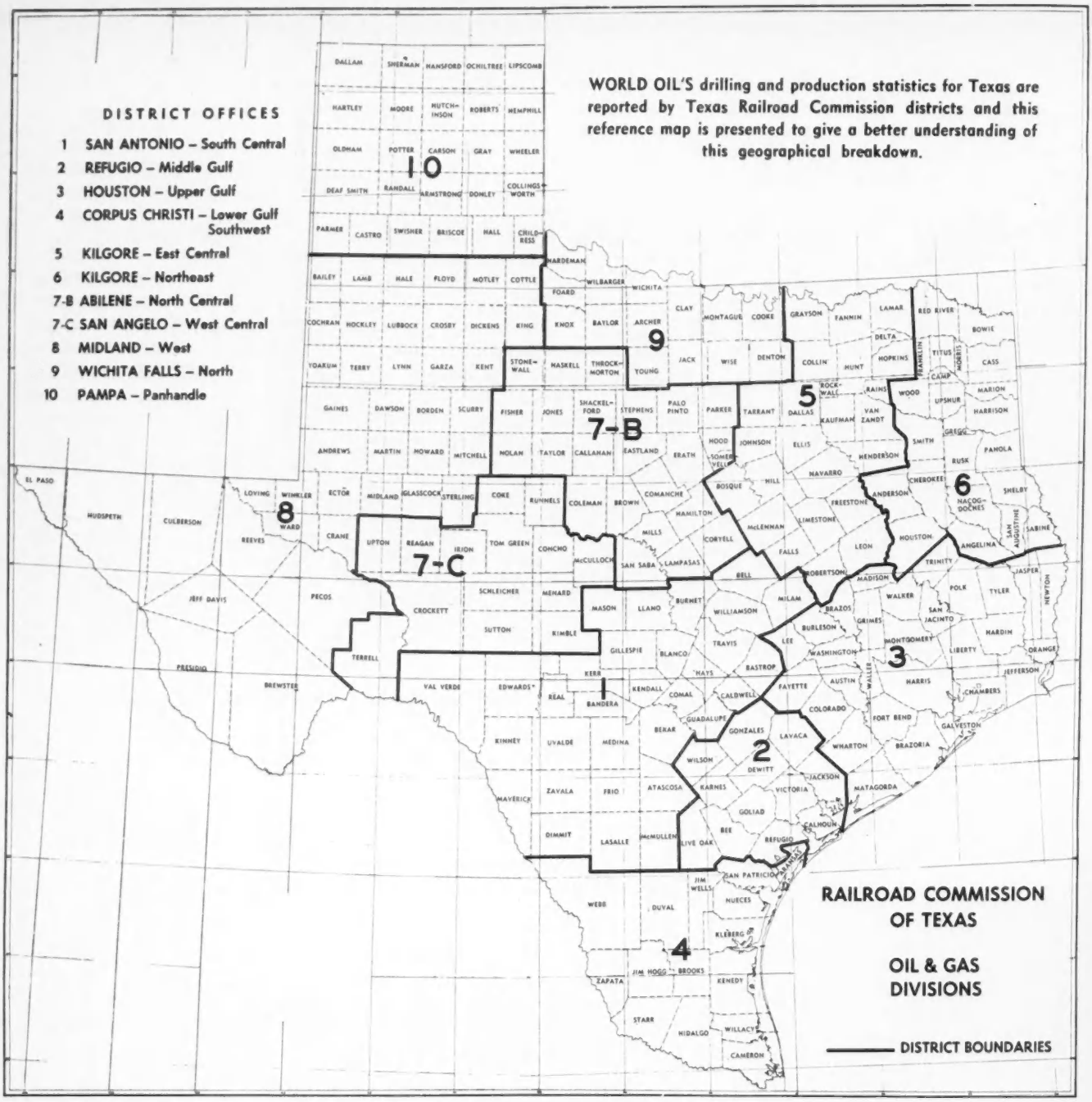
Summary of Results of Exploratory Drilling

ITEM	May, 1950	April, 1950	FIVE MONTHS· Jan.-May 1950	1949	Percent Diff.
Oil Discoveries	101	78	406	386	+ 5.2
New Fields	72	67	295	263	+ 12.2
New Pays	29	11	111	123	— 9.8
Distillate Discoveries	4	6	31	64	— 51.6
New Fields	4	5	27	35	— 22.9
New Pays		1	4	29	— 86.2
Gas Discoveries	14	4	56	53	+ 5.7
New Fields	13	3	50	42	+ 19.0
New Pays	1	1	6	11	— 45.5
Total Discoveries	119	88	493	503	— 2.0
Extensions to Fields	32	21	127	107	+ 18.7
Oil Fields	28	20	112	96	+ 16.7
Distillate Fields	1	.....	4	7	— 42.9
Gas Fields	3	1	11	4	+175.0
Total Prod. Tests	151	109	620	610	+ 1.6
Dry Holes	583	505	2,527	2,312	+ 9.3
Wildcats	569	494	2,426	2,287	+ 6.1
New Pays		1	5	2	+150.0
Outposts	14	10	96	23	+317.4
Total Expl'tory Tests	734	614	3,147	2,922	+ 7.7
Percent Productive	20.6	17.8	19.7	20.9	.....
Percent Dry	79.4	82.2	80.3	79.1	.....

(See Tables on Pages 80-82-84)

Results of Exploratory Drilling in May and First Five Months, 1950-1949, by Districts

State or District	MONTH OF MAY, 1950													FIRST FIVE MONTHS, 1950																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Unproductive Tests						Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions										
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	5 Mo. 1950	5 Mo. 1949	Wildcats	New Pays	Outposts	Total Dry 5 Mo. 1950	Total Dry 5 Mo. 1949	5 Mo. 1950	5 Mo. 1949
Alabama											2			2			1							1		8			8	6	9	6
Arizona																													3		3
Arkansas	1									1	10			11	4	1								5	4	32		2	34	18	39	22
California	2			1			2			5	33		3	41	9		1	3			6		1	20	21	141	2	8	151	113	171	134
Colorado											3			3												13		1	14	18	14	18
Florida											1			1												5			5	7	5	7
Georgia																										3			3	4	3	4
Idaho																										3			3		3	
Illinois	2						8		1	11	36			47	8			4			27		1	40	34	225			225	189	265	223
Indiana	1			3						4	37			41	11			3			1			15	25	149		4	153	159	168	184
Kansas	11									11	81			92	41		1							42	31	229			229	151	271	182
Kentucky											3			3	2		1							3	3	16			16	14	19	17
Louisiana	4	1		1			2			8	18			26	12	7	2	6	2	2	7		1	39	51	80	1		81	91	120	142
North Louisiana		1					2			3	8			11	1	1			2	2	4		1	11	13	33	1		34	44	45	57
South Louisiana	4			1						5	10			15	11	6	2	6			3			28	38	37			37	47	75	85
Maryland																										1			1		1	
Michigan	3		1				1			5	20			25	13		4	1			1			19	14	105			105	137	124	151
Mississippi								1		1	14			15	7	2		1				2		12	4	62		3	65	47	77	51
Missouri																										2			2	1	2	1
Montana											3			3							1			1	1	21			21	10	22	11
Nebraska	1									1	3			4	1		1			1	1		1	4		14			14		18	
New Mexico	1			1			1			3	4			7	8			4			5			17	8	20		3	23	24	40	32
Ohio																					1		1	2	3	5			5	18	7	21
Oklahoma	8			5			4			17	70			87	32		2	14			11	1	1	61	42	211			211	187	272	229
Pennsylvania																									1				1		2
South Dakota																										2			2		2	
Tennessee											1			1										1		4			4	10	4	11
Texas	37	3	12	16		1	8		2	79	224		10	313	143	17	37	71	2	4	49	1	5	329	348	1041	1	72	1114	1048	1443	1396
Dist. 1 S. Central	2									2	16		1	19	6		1			1				8	8	79		1	80	105	88	113
Dist. 2 Middle Gulf	2		3						1	6	13		1	20	6	4	8	3	1	1			1	24	31	48		6	54	67	78	98
Dist. 3 Upper Gulf	1	1		3		1	3		1	10	16		2	28	6	4	1	16	1	1	5	1	3	38	55	72		10	82	109	120	164
Dist. 4 L. Gulf-SW	3		3	2						8	28			36	9	3	10	19		1				42	50	118		3	121	167	163	217
Dist. 5 E. Central	1									1	5			6	2						1			3	2	26			26	34	29	36
Dist. 6 Northeast	2	2								4	6			10	4	3		2			2		1	12	10	35	1	3	39	27	51	37
Dist. 7-B N.Central	8		4	4						16	55		2	73	46	1	8	8			4			67	77	230		13	243	231	310	308
Dist. 7-C W. Cent.	1		1	1						3	3		1	7	6	1	1	4			5			17	14	71		9	80	42	97	56
Dist. 8 West	5			4			5			14	25		2	41	27			14			19			60	40	113		12	125	79	185	119
Dist. 9 North	12		1	2						15	57		1	73	30	1	8	5			13			57	60	245		15	260	185	317	245
Dist. 10 Panhandle															1									1	1	4			4	2	5	3
Utah																		1						1	1	4			4	5	5	6
Washington															1									1		1			1		2	
West Virginia																									4				1		5
Wyoming	1			2			2			5	6		1	12	3			3			2			8	14	29	1	3	33	50	41	84
Total U. S.	72	4	13	29		1	28	1	3	151	569		14	734	295	27	50	111	4	6	112	4	11	620	610	2426	5	96	2527	2312	3147	2922


DISTRICT OFFICES
1 SAN ANTONIO – South Central
2 REFUGIO – Middle Gulf
3 HOUSTON – Upper Gulf
4 CORPUS CHRISTI – Lower Gulf Southwest
5 KILGORE – East Central
6 KILGORE – Northeast
7-B ABILENE – North Central
7-C SAN ANGELO – West Central
8 MIDLAND – West
9 WICHITA FALLS – North
10 PAMPA – Panhandle
WORLD OIL'S drilling and production statistics for Texas are reported by Texas Railroad Commission districts and this reference map is presented to give a better understanding of this geographical breakdown.
RAILROAD COMMISSION OF TEXAS
OIL & GAS DIVISIONS
DISTRICT BOUNDARIES

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in May, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Field						
Nevada	.....	Burnett Drilling Co. & C. O. Day et al's V. B. May 1, c nw se 8-14s-22w. 1 mi sw of Bodcaw. 6 mi n of Falconfld.	5-22-50	5440	2545- 2550	Hill sd; L. Cre.	P 80	.....
		CALIFORNIA—New Oil Fields						
Riverside	.....	Fife Bros' Orangethorpe 1 (OWDD), 400 n 405 e fr se cor Sect. 28-4s-6w	5-10-50	670	593- 651	.....	P 5	.....
San Luis Obispo	.....	Hancock Oil Co's Hancock Oceanic 65-10, 330 s 990 e fr center Sect. 10-11n-28w. N. Cuyama Valley area.	4-25-50	2492	1695- 1950	Morales sd; U. Mio.	P 64	32.1
		CALIFORNIA—New Oil Pay						
Los Angeles	Signal Hill	Jack C. Roger's Enterprise 1, Sect. 30-4s-12w	5-18-50	2860	2306- 2404	.....	P 348	21.8
		CALIFORNIA—Oil Field Extensions						
Kern	Calder	General Petroleum Corp's Sturdevant 61-26, Sect. 26-29s-25e. ½ mi e ext	5- 1-50	8889	8800- 8787	Stevens sd; Mio.	P 92	36.8
Los Angeles	Newhall Placerita	Harold E. Willhoit & John D. Willhoit's Willhoit 1, 500 s 500w fr ne cor se¼ Sect, 4-3n-15w. 2 mi se extension.	5- 5-50	1173	1055- 1173		P 2	45
		ILLINOIS—New Oil Fields						
White	Enfield	S. L. Desdmand & Herndon's I. Dunn 1, 330 nl 380 el, ne nw 29-5s-8e. 3½ mi se of Thackerey fld.	5-29-50	3296	3280- 3285	Aux Vases sd; Miss.	P 175; 3 wtr	.....
Williamson	Marion	T. M. Pruett's Norris-Weisbroht Comm. 1 (OWWO), nw se nw 7-9s-3e.	5-16-50	2560	2390- 2395	Aux Vases sd; Miss.	P 25; 15 wtr	.....
		ILLINOIS—Oil Field Extensions						
Clay	Oskaloosa	F. B. Drilling Co's R. Harrell 1, ne nw ne 3-3n-5e. ¾ mi s extension	5-16-50	2680	2666- 2680	Bethel sd; Miss.	P 65	.....
Edwards	Maplegrove, E.	J. W. Rudy's A. Hayner 1, 990 nl 416 el nw sw 1-1n-10e. ¾ mi nw extension.	5-23-50	3205	3201- 3204	McClosky li; Miss	P 24; 64 wtr	.....
Hamilton	Blairsville	C. E. Brehm's E. M. Smith 1, ne se ne 16-4s-7e. ¾ mi ne extension	5-16-50	3437	3274- 3283	Aux Vases sd; Miss.	F 127	.....
Hamilton	Walpole	Oil Management's Howard 1, se sc ne 4-7s-6e. ½ mi s extension	5-23-50	3197	3185- 3195	Aux Vases sd; Miss.	P 14; 100 wtr	.....
Madison	Livingston	J. Kesl, Jr's Engelke 1, 150 nl 560 wl, sw nw 29-6n-6w. 1½ mi s extension.	5-23-50	545	527- 545	Pennsylvanian sd; Penn.	P 10; 10 wtr	.....
Madison	Livingston, S.	B. Roan's E, Blom 1, nw nw sw 27-6n-6w. ½ mi e extension	5-23-50	581	569- 571	Pennsylvanian sd; Penn.	P 2; 20 wtr	.....
Richland	Calhoun Cons.	F. L. Runyon's D. Olcese 1, ne nw nw 4-2n-10e. ¾ mi ne extension	5-23-50	3189	3184- 3189	Rosiclare li; Miss.	P 120	.....
White	Herald	Coy Oil Co's L. D. Austin 1, ne ne se 28-6s-9e. ½ mi w extension	5-29-50	3012	2310- 2340	Waltersburg sd; Miss.	P 18	.....

BREWSTER N-7 DRAWWORKS

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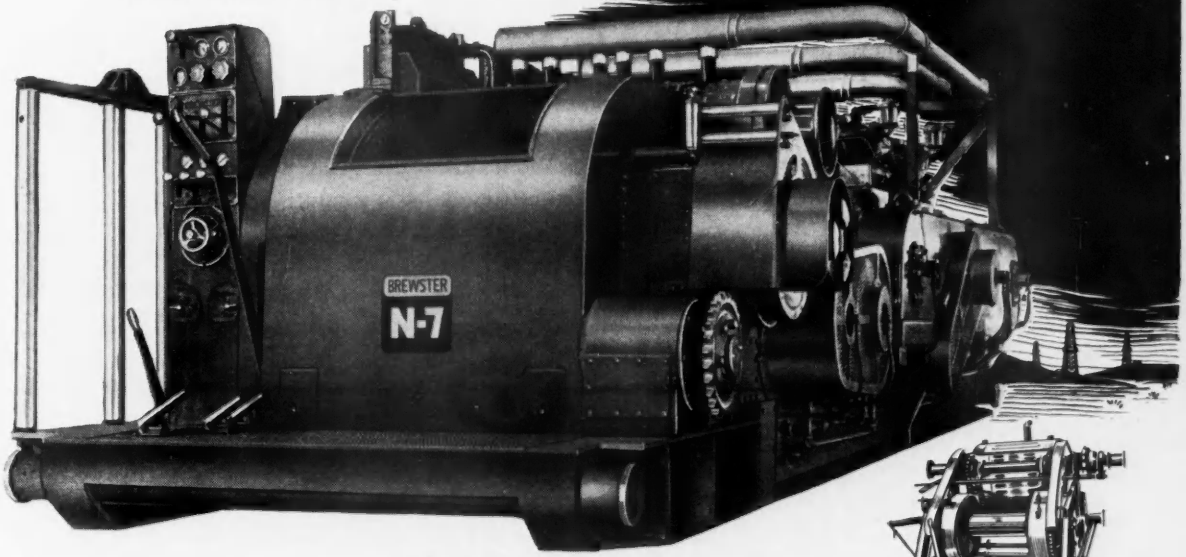

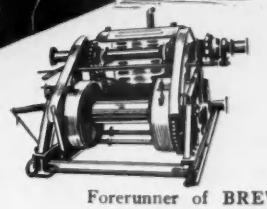

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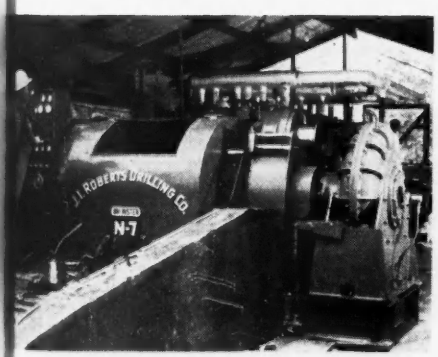

BREWSTER N-7 drawworks, 600 h.p. transmission. Has four forward speeds, one reverse, makes eight drum speeds and four Rotary speeds.

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BREWSTER

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ILLINOIS—Gas Field Extension						
Gallatin	Cottonwood	C. E. Skiles' J. P. Holland 1, sw sw ne 28-7s-9e. ¾ mi nw extension	5-23-50	3090	2314- 2325	Tar Springs sd; Miss.	0.3 mln	
		INDIANA—New Oil Field						
Knox	Beaman, S.	Don McCumber's Alexander 1, Sect. 25-3n-11w. sw of Vincennes	5-19-50	1886	1879- 1882	Rosiclare li; Miss.	P 12	
		INDIANA—New Oil Pays						
Gibson	Princeton, N.	J. Cline & H. Lovelace's Gieselman-YMCA el at 1, sw nw nw 9-2s-10w.	5-18-50	1803	1795- 1803	Cypress sd; Miss.	P 58	
Posey	Ford, S.	W. C. McBride's A Feldmann 1, nw sw nw 27-6s-12w	5-11-50	2325	2320- 2325	Cypress sd; Miss.	P 155	
Posey	Oliver, S.	Superior Oil Co's T. Kaffenberger 1, se nw se 10-6s-13w	5-17-50	2893	2762- 2768	Aux Vases sd; Miss.	P 556	
		KANSAS—New Oil Fields						
Barton	Bloomingdale	Henderson Oil Co's Jordan 1, sw sw se 8-18s-11w, 2 mi sw of Ames, nw fld.	5-12-50	3381	3368- 3381	Arbuckle li; Ord.	P 47	
Barton	Capitol View	Lewis Drilling Co's Dietz 1, sw sw nw 9-17s-14w. 2 mi n of Carroll fld.	5-22-50	3496	3230- 3240	Lansing li; Penn.	P 129	
		KANSAS—New Oil Fields						
Barton	Rusco	Alrine & Bradley Bros' Rusco 1, sw sw se 8-19s-12w. 6 mi n of Great Bend.	5-21-50	3442	3417- 3442	Arbuckle li; Ord.	P 25	
Barton		Herndon Drilling Co's Eveleigh 1, se se nw 9-18s 13w 1½ mi e Eveleigh fld.	5-20-50	3316	3078- 3162	Lansing li; Penn.	P 10	
Butler		Marhenke Drlg et al's Doyle 1, ne ne sw 13-29s-4e 3 mi e of Douglas fld.	5-25-50	2830	2812- 2829	Bartlesville sd; Penn.	P 40	
Graham	Fargo	Peel & Hardman's De Sair 1, se se se 26-9s-22w. 3 mi sw of Morel fld.	5-23-50	3977	3622- 3629	Lansing-K.C. li; Penn.	P 431	
Graham	Smith-Denning	Westgate Greenland Oil Co's Smith 1, ne ne nw 5-10s-21w. 3 mi sw of Morel fld.	5- 4-50	3822	3818- 3822	Arbuckle li; Ord.	Sw 1981	
Graham	Wild Horse Creek	Aurora Gasoline and Peel & Hardman's Walker 1, ne ne ne 16-9s-22w. 4 mi w of Morel fld.	5-18-50	3962	3946- 3962	Arbuckle li; Ord.	P 442	20.8
Hodgeman	"Jetmore"	Shell Oil Co's Springer 1, se sw sw 24-22s-24w. 2 mi n of Jetmore	5-20-50	5148	4580- 4600	U. Mississippi li; Miss	Sw 576	38
Rooks	Kern	Reserve Drilling Co's Kern 1, nw nw sw 28-9s-20w 1 mi w of Northampton fld.	5-21-50	3859	3855- 3859	Arbuckle li; Ord.	Sw 1200	
Stafford	Eden Valley	Petroleum Inc's Keller B-1, se ne sw 29-21s-13w. 1 mi sw of Hazel, S. fld.	5-28-50	3782	3748- 3750	Arbuckle li. Ord	P 42	
		NORTH LOUISIANA—Oil Field Extensions						
Claiborne	Haynesville, E.	Hunt Oil Co's Leroy Ware 1, 848 fr sl 2048 fr wl Sect, 7-23-6w. ½ mi e extension.	5- 8-50	10495	10003-10064	Smackover li; Jur.	F 768; ¼"	49.9
Claiborne	Haynesville, E.	Midstates Oil Corp's Town of Haynesville 1, 1577 fr nl 1822 fr el Sect, 30-23n-7w. 1¼ mi e extension.	5-21-50	5466	5398- 5406	Pettit li; L. Cre.	F 229; ½"	39.5
		NORTH LOUISIANA—New Distillate Field						
Lincoln	Unionville	Southwest Natural Prod. Co's Mrs. M. E. Colvin et al 1, c nw nw se 31-20n-2w.	5-11-50	9004	8566- 8572	"D" sd; Jur.	F 85;2.2 mln; ¼"	59
					8738- 8756	Vaughn sd; Jur.	F 100; 5 mln; ⅜"	56
		SOUTH LOUISIANA—New Oil Fields						
Acadia		Kirby Petroleum Co's Maggie McCain Kerr 1, 990 n 600 w fr se cor Sect. 11-9s-1w. 4 mi ne Egan fld.	5- 5-50	11012	10039-10043		F 220; 2/64"	39.7
Plaquemines	Blk. 24	Shell Oil Co's State Lse 1008 1, 660 fr n&el of Blk 24. Gulf of Mexico, South Pass area.	4-26-50	12128	6530- 6534		F 55; 5/16"	22.7
Plaquemines		Placid Oil Co & The Texas Co's State of La-LL&E 5-1, 1980 e 660 n fr sw cor Sect. 1-21s-26e. 3 mi s of Lake Washington area.	5- 4-50	10032	7824- 7834		F 178; 1/8"	37.5
Pointe Coupee		Sinclair O&G Co's H. M. Kimbell 1, 1980 e 660 n of sw cor Sect. 20-6s-10e, 8 mi n of Rosedale fld. 3½ mi w of Erwinville Twst.	5-30-50	11200	9205- 9207		F 115; 5/32"	42.5
		SOUTH LOUISIANA—New Oil Pay						
St. Mary	Belle Isle	The Texas Company's State Lse 40-8 (OWWO),Sect. 6-18s-11e,	4-23-50	9647	8630- 8640		F 184; 1/8"	31.3
		MICHIGAN—New Oil Fields						
Allegan		Dale M. Leonard's Haddaway 1, n½ ne ne 8-1n-16w. Casco Twp.	5-24-50	1189	1156- 1161	Traverse li; Devo.	P 2	
Bay		Ervin Major's Koelsch 1, ne nw nw 11-18n-3e, Gibson Twp. s of Adams, s fld	5-20-50	2174	2062- 2124	Traverse li; Devo.	P 68	
Van Buren		Harris Oil Co's Horton 1, sw se ne 27-1s-15w. Columbia Twp.	5-18-50	1131	1126- 1129	Traverse li; Devo.	P 10	
		MICHIGAN—Oil Field Extensions						
Roscommon	St. Helen	A. F. & W. A. Steiner's Childers 1, n½ se ne 15-24n-1w. 1 mi ne extension	5-10-50	4368		Richfield li; Devo.	P 12	
		MICHIGAN—New Gas Field						
Muskegon		Charles D. Hoffman's Buchannan 1, nw nw se 19-11n-15w. Cedar Creek Twp.	5-21-50	1127	1119- 1127	Berea sd; Miss	0.8 mln.	
		MISSISSIPPI—Distillate Field Extension						
Jones	Soso	Gulf Refining Co's B. L. Moss 1-B, c e½ nw sw 32-10n-12w. ¾ mi e extension.	5-10-50	6641	6444- 6470	Stanley sd; U. Cre.	F 18; 2.2 mln; ¼"	58.7
		NEBRASKA—New Oil Field						
Cheyenne		Ohio Oil Co's John M. McLernon 1, ne ne ne 9-14n-49w	5-10-50	5016	4490- 4504	First Dakota sd; Cre.	P 121	
		NEW MEXICO—New Oil Field						
Chaves		Magnolia Petroleum Co's Lightcap Land Company 1, 660 fr s&el of Sect. 6-8s-30e. 30 mi nw of Bagley fld. 11 mi se of Elkins.	5-12-50	7978	7960- 7976	Devonian li; Devo.	F 492; ¼"	52
		NEW MEXICO—New Oil Pay						
Lea	Maljamar	Buffalo Oil Co's Mitchell "B" 20-P, ne se 19-17s-32e	5- 2-50	5286	5270- 5286	Paddock dolo; Perm.	F 163; 5/16"	36
		NEW MEXICO—Oil Field Extension						
Lea	House	Union Oil Co's C. H. Kyte 1, 1980 fr sl 330 fr wl of Sect. 5-20s-39e. 1 mi e extension	5- 9-50	7738	4357- 4410	San Andres li; Perm.	P 153	31
		OKLAHOMA—New Oil Fields						
Kiowa		Terrell-Mead's J. T. Brazel 1 (OWDD), se sw ne 34-7n-17w	5-13-50	973	962- 973		P 25; 40 wtr.	36
Lincoln		F. V. Anderson's Kolar 1 (OWWO), se se nw 27-12n-6e	5-12-50	4515	3220- 3236	Prue sd; Penn.	P 10; 2 wtr.	34
Lincoln	"Sunflower"	Coronado Oil Co's Kriel 1, sw sw nw 20-14n-2e	5- 9-50	5007	4872- 4882	L. Skinner sd; Penn.	F 45	
Lincoln		Creekmore-Rooney et al's Elmer James 1 (OWDD), ne ne se 32-14n-6e. 2½ mi nw of Davenport S.E. fld.	5-22-50	3113	3063- 3113	Prue sd; Penn.	F 48	43
Okfuskee		Herndon Drilling Co's Harjo 1, ne ne se 27-12n-9e. nw of Okemah	5-26-50	3275	3269- 3275	Cromwell sd; Penn.	F 36	42
Payne	Paradise, S.E.	Kingwood Oil Co's E. J. Murphy 1, sw sw se 27-18n-1e. 15 mi sw of Stillwater.	5-13-50	4829	4784- 4816	Bartlesville sd; Penn.	P 62; 15 wtr.	38
Payne		Wood Oil Co's Howard Easton 1, sw ne sw 35-19n-4e. 7 mi nw Cushing	5- 6-50	3535	3485- 3535	Red Fork sd; Penn.	F 50; 2"	
Seminole		Kingery Bros' Boren 1, sw ne sw 1-6n-6e	5-24-50	2901	2103- 2112	L. Senora sd; Penn.	F 25	34.5
		OKLAHOMA—New Oil Pays						
Cleveland	Newcastle, S.E.	Producers Development Co's Neher & Meadors 1, c sw sw 20-9n-3w	5- 6-50	9600	9357- 9430	Viola li; Ord.	F 110; 7/13"	
Lincoln	Hally Valley	Comail Oil's Kaskins 1 A (OWWO), sw sw sw 19-17n-6e. ne of prod.	5-28-50	3400	2940- 2959	Prue sd; Penn.	F 5; 5/64"	40
Logan	Langston, S.	Alpha Petroleum & Eugene Jordan's Kemp 1, ne ne se 1-16n-1w	5- 8-50	5098	4302- 4308	Cleveland sd; Penn.	P 50	40
Noble	Lucien	Bay Petroleum Co's Ferguson 1, c n½ nw sw 34-20n-2w	5-27-50	3628	3611- 3625	Perry sd; Penn.	F 62; 1/8"	39.2
Okfuskee	Garden Grove, N.	Josaline Prod. Co's Southerland 1, ne se se 19-12n-7e	5- 7-50	3151	3128- 3142	Skinner sd; Penn.	F 20; 15 wtr.	34
		OKLAHOMA—Oil Field Extensions						
Beckham	Elk City	Shell Oil Co's State of Oklahoma "F" 1, c se sw 12-10n-22w. 1¼ mi w extension.	5- 7-50	10160	9965- 9985	Hoxbar cgl; Penn.	F 303; 3/8"	49
Creek	Cushing, E.	Denver H. Daugherty & Ralph W. Casey's Oller-Rummage 1, ne ne sw 17-19n-8e. ⅝ mi e extension.	5-23-50	2542	2537- 2542	Red Fork sd; Penn.	F 115; ½"	39
Garvin	Maysville, SW	W. E. Anderson & Phillip's Rill 1, c ne nw 34-4n-3w. 1 mi w extension	5-28-50	7331	7012- 7040	Gibson sd; Penn.	F 135; 7/32"	42
					7113- 7134	Hart sd; Penn.	F 125; 5/13"	Dist.
Stephens	Sholem Alechem	Stanolind O&G Co's E. F. Thacker 1, sw nw nw 25-1s-4w	5- 7-50	6514	5630- 5660	Springer sd; Penn.	P 103	23.8
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Fields						
Bexar		N. B. Duke's A. Pinaniezk 1, 100-ac. Lse, J. W. Rials Sur. 11, 15 mi e of San Antonio. s of Cooksey fld.	4-15-50	1530	1514- 1530		P 6	36
McMullen		Ryan, Hays & Burke's Geo. T. Jambers 1, 2724 fr nwl 6000 fr nel of James Freal Sur. 155, 8 mi nw of Calliham.	5- 6-50	5903	5899- 5902	L. Wilcox sd; Eoc.	F 120; 5/32"	42.9
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
Goliad		Magnolia Petroleum Co's C. C. Diebel 1, 202-ac Lse, Sampson McTornall Gr., 2½ mi w of Berclair,	5-17-50	3215	2537- 2543		P 5	24.5
Live Oak		James G. McCarrick Tr's Mary E. Sullivan 1, 1470 fr sl 2490 fr wl of Sect. 92 Simmon Sbdn. 7 mi sw of Geo. West.	5- 8-50	7504	6805- 6817		F 56; ¼"	31
		TEXAS—District 2 (MIDDLE GULF)—New Gas Fields						
Goliad		Ranger & Coffield's W. Karnei 1, 2400 fr sel 3400 fr nel James Cunningham Sur. ¾ mi se Melrose fld.	4-16-50	8255	7896- 7902		2 mln; 7/64"	
Live Oak		Henderson Coquat's Wyatt Curry 1, 770 fr swly swl 870 fr nwly sel of AB&M Sur. 2½ mi ne of Coquat fld.	4-16-50	8004	7270- 7280	Luling sd; Eoc.	60 mln; open	
Live Oak		S. H. Howell's Joe Doubrava 1, 175-ac Lse, Refugio CSL Sur. 10 mi nw of Tynan.	5-31-50	4497	3959- 3965		F 130 mln; open	
		TEXAS—District 2 (MIDDLE GULF)—Gas Field Extension						
Goliad	Weesatche, S.	Sun Oil Co's Dohmann Gas Unit 2, 1900 fr el 3010 fr sl Robt. Walker & Jno. Payne Sur.	5-26-50	5057	5037- 5053		21 mln; open	

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147 hospitals and other medical groups

1,825 small and large businesses

219 churches, religious organizations

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COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		TEXAS—District 3 (UPPER GULF)—New Oil Field						
Tyler	"Swearingen"	C. N. Housh's Charles Kieke 1, 1000 fr wl 330 fr sl of BB&C Sur. 3 mi s of E. Hillister fld. 7 mi e of Warren.	5- 2-50	8400	8376- 8384	Wilcox sd; Eoc.	F 181; 8/64"	42
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Colorado	Frelsburg	Midstates Oil Corp's Suchadoll 1, 5900 fr nl 1000 fr el F. A. Zimmerschield Sur.	4- 3-50	9600	8120- 8132	Wilcox sd; Eoc.	F 61; 4/16"	36.5
Fort Bend	Boling Dome	Callery & Hurt's John Kasparek 2, 64-ac. Lse, Simon & Miller Lge 2	5- 2-50	3598	3589- 3598		P 129	21,8
Matagorda	Hamman	Hamman Oil & Refining Co's E. Richers 2, (OWDD) 371-24-ac. Tr. P. Bertrand Sur.	5-22-50	10891	10693-10700	Frio sd; Olig.	F 203; 7/64"	36.3
		TEXAS—District 3 (UPPER GULF)—Oil Field Extensions						
Hardin	Nona Mills	General Crude Oil Co's Nona Mills Co. 2, 513.96-ac Lse, BBB&C Sur. 1 mi sw extension.	5-13-50	8512	8271- 8250		F 216; 5/32"	39.6
Harris	Goose Creek	Production Service Oil Corp. et al's Tavary 1, 65 fr el Lot 8, 75 fr sl Lot 9, Harvey Whiting Sur. n extension.	5-26-50	5207	4258- 4268	Frio sd; Olig.	F 82; 6/64"	21.2
Jefferson	Amelia	John W. Angelo, Chas. Angelo, Jack Faulds' John W. Angelo 1, 56.12-ac Lse, Chas Williams Sur. ½ mi ne extension.	5-27-50	6817	6783- 6785	Frio sd; Olig.	F 140; 8/64"	29.6
		TEXAS—District 3 (UPPER GULF)—New Gas Pay						
Brazos	Millican	Marshall Stone & C. H. Bass' Wharton Weems 1, 280-ac Lse. J. M. Barrera Sur. north flk of Millican Dome	5-23-50	4000	2611- 2616	Queen City sd; Eoc.	6.5 mln; open	....
		TEXAS—District 3 (UPPER GULF)—Gas Field Extension						
Liberty	Cottonwood, N.	Wm. Herbert Hunt Trust Estate's Mrs. M. P. Ebie 1, 320-ac tr in GC&SF Ry Sur 17 8 mi se of Raywood 2 mi sw extension.	5-31-50	8052	7930- 7938	Frio sd; Olig.	F 42 mln; open	....
		TEXAS—District 3 (UPPER GULF)—New Distillate Field						
Chambers		Humble O&R Co's Galveston Bay-State E-1, 9322-ac. "E" Lse, Tr 17-B, Galveston Bay. 5 mi sw of Anahuac.	5-27-50	9291	8790- 8800	Frio sd; Olig.	F 12; 1.6 mln; 4/16"	55.6
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Fields						
Brooks	"Gruy"	Argo Oil Corp's Joseph Gruy Tr. C-1, 467 fr s&el J. G. Reynolds Sur. 2½ mi sw of Poquito Crk fld.	5-19-50	3810	2610- 2626	Dougherty sd; Olig.	P 53	25.5
Duval	"Atlee"	H. R. Smith, F. Wm. Carr & W. E. Fox, Trustee's Atlee Parr 1, 30,500 fr wl San Andres Gr. 1 mi ne of Sweden fld.	5-21-50	5010	4924- 4930 5002- 5008	Teddlie sd; Eoc. Woodley sd; Eoc.	F 105; 1/8" F 127; 8/64"	47.7 47.7
Zapata		C. C. Tedford et al's Cuellar Bros. 1-B, 330 fr nel 990 fr sel of TCRR Sur. 245. 25 mi s of Mirando City.	4- 1-50	1340	1319- 1340		P 3	24.8
		TEXAS—District 4 (LOWER GULF-S. W.)—New Oil Pays						
San Patricio	Portilla	The Superior Oil Co's Minnie S. Welder 2, 330 fr wl 990 fr nl of Sect. 23, Welder Ranch Subd, C. J. Francisco & E. Portilla Sur.	5- 2-50	9629	7120- 7125		F 210; 5/32"	41.8
Willacy	La Sal Vieja	G. L. Reasor's Dale Johnson et al 1, 330 fr s&el of Lot 11, Blk 29, Harding-Lindahl Subd. nw of production.	4- 1-50	8591	7010- 7020		F 50; ¾"	39.6
		TEXAS—District 4 (LOWER GULF-S.W.)—New Gas Fields						
Duval		Ralph E. Fair & Woodward & Co's C. W. Hahl Co 1, 2359 fr wl 2363 fr nl L. Rodriquez Sur. 56, 3 mi nw of Freer	5-27-50	7610	7575- 7610		2 mln; ¼"	48.3
Jim Wells		The Texas Co's Ed. C. Adams 1, 330 fr nl 902 sw of nly ne cor Juan Hernadez Sur 10, 2 mi w of Alfred.	5-26-50	4105	2500- 2510		8.3 mln; open	....
Jim Wells	Tom Graham, W.	W. B. Osborn "Operator" Mrs. Mittie Holshouser 1, 330 fr el 260 fr sl Farm Blk 96, 1 mi sw of Alice.	5- 2-50	5320	4996- 5011	Seiler sd; Olig.	3.2 mln; open	....
		TEXAS—District 5 (EAST CENTRAL)—New Oil Field						
Navarro		Coffield & Guthrie, Inc's A. M. Kelly 1, 400 fr nl 525 fr el of M. Autrey Sur. 2 mi s of Navarro.	5-24-50	3001	2985- 2998	Woodbine sd; U. Cre.	P 32	36.4
		TEXAS—District 6 (NORTHEAST)—New Oil Fields						
Shelby		S. J. Carnes' Pickering Lumber Corp. 1, 641.2-ac. Tr. in R. S. Forbes Sur. 6 mi e Patroon.	4-27-50	3760	3667- 3673	Fredericksburg li; L. Cre.	P 32; 23 wtr.	38.6
Wood		W. W. Wise et al's J. E. Brown et al 1, 467 fr nl 660 fr el of J. C. Clark Sur. 5½ mi ne of Quitman.	4-10-50	4744	4440- 4473	Sub-Clarksville sd; Cre.	F 168; open	17
		TEXAS—District 6 (NORTHEAST)—New Distillate Fields						
Cherokee		Union Producing Co's Sanders et al 1, 800 fr wl 661 fr nl of Lse, F. J. Anthony Sur. 8½ mi ne of Jacksonville.	5-26-50	5000	4313- 4323	Woodbine sd; U. Cre.	No gge; 105 mln open	....
Nacogdoches		Humble O&R Co's Mrs. Ruth Frank et al 1, 3400 fr sl 6150 fr el of Jefferson Wilson Sur. 4 mi se Douglass.	5-20-50	9621	8044- 8060	Rodessa li; L. Cre.	F 3; 3.1 mln; 4/16"	48.7
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Field						
Runnels		Kingford Oil Co's D. E. H. Barnett 1, 2000 fr nwl 19500 fr nel of R. Christa Sur. 1¾ mi w Ballinger fld.	5- 4-50	3069	3063- 3069	Canyon sd; Penn.	P 103	43.3
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Pay						
Runnels	Winters	Ted Weiner et al & Anton Oil Co's Mrs. M. J. Arnold 1, 3063 fr nl 2372 fr wl of Sect. 332, E. Morris Sur.	5-26-50	2555	2538- 2546	Serratt sd; Penn.	F 192; ¼"	44
		TEXAS—District 7-C (WEST CENTRAL)—New Gas Field						
Runnels		E. S. Price Oils' W. A. Ashton 1, 1980 fr el 660 fr nl of Sect. 143, ETRR Sur. 9 mi ne Ballinger. 3 mi e Beddo fld.	4-28-50	4268	3773- 3779	Gardner sd; Penn.	0.4 mln; ¼"	....
		TEXAS—District 8 (WEST)—New Oil Fields						
Hockley		Honolulu Oil Corp & Signal O&G Co's M. D. Underwood 1-13, 510 fr n&el of Lab 13, Lge 5. Wilbarger CSL Sur.	5-21-50	9325	9290- 9325	Cisco Reef li; Penn.	F 2236; 1"	42
Kent		Barnsdall Oil Co's R. L. Spires 1, 3300 fr nl 1980 fr wl of Sect. 22, Blk. 4, H&GN Sur. 5 mi nw of Cogdell fld.	5- 1-50	7564	6755- 6771	Strawn sd; Penn.	F 400; ½"	42
Kent		Spartan Drlg. Co., Lone Star Prod. Co., & Signal O&G Co's J. W. Young 1, 660 fr n&wl of Sect. 98, Blk. G, W&NW Sur. 11 mi w Claremont.	5- 7-50	7895	7353- 7359	L. Strawn sd; Penn.	P 52	38.1
Lynn		Magnolia Pet. Co's Garza Land & Cattle Co. 1, 1980 fr sl 660 fr wl of SE¼ of Sect. 431, Blk. 9, ELRR Sur. 16 mi sw Post.	5- 3-50	8630	8615- 8630	Canyon Reef li; Penn.	F 245; 3/8"	42.2
Winkler		Phillips Petroleum Co's R. F. Waddell et al 1, 660 fr s&wl of SE¼ Sect. 5, Blk. B-7, PSL Sur. 15 mi e of Kermit, 1 mi nw Wheeler fld.	4-27-50	10775	10730-10775	Ellenburger dolo; Ord.	F 1362; ½"	43
		TEXAS—District 8 (WEST)—New Oil Pays						
Andrews	Fuhrman-Mascho	Fuhrman Petroleum Co's W. T. Ford 17 (OWDD), 1430 fr wl 1210 fr sl of Sect. 16, Blk A-43, PSL Sur.	5-13-50	5612	5570- 5612	Glorietta li; Perm.	F 250	29
Crane	Block 31	Bearo & Tullous, Inc's University 1, 660 fr sl 330 fr wl of SE¼ Sect. 23, Blk 31 Umvhands Sur.	5-13-50	4343	4275- 4343	Clear Fork li; Perm.	P 174	39.7
Gaines	Hobbs, E.	Humble O&R Co's John S. Jones 1, 1980 fr nl 1812.5 fr el of Sect. 6, Blk A-10, PSL Sur.	4-28-50	6430	3750- 3780	Queen sd; Perm.	F 9; ½"	25.1
Pecos	Abell (Silurian-Montoya)	Magnolia Petroleum Co's State Vollmar 2, 330 fr n&wl of lot 7, Sect. 28, Blk. 9, H&GN Sur.	5-23-50	6030	6008- 6030	Waddell sd; Ord.	F 311 3/8"	44.2
		TEXAS—District 8 (WEST)—Oil Field Extension						
Borden	Reinecke	Castleman & O'Neill et al's T. L. Griffin 1-B, 467 fr n&el of SE¼ of Sect. 51, Blk 25, H&TC Sur. ½ mi s extension.	5-16-50	7028	7014- 7028	Canyon Reef li; Penn.	F 364; ¼"	42
Gaines	Cedar Lake	Ted Weiner et al's J. O. Jones et al 1-A, 660 fr wl 1980 fr nl of Sect. 2, Blk H D&W Sur. 2 mi n extension.	4-19-50	4848	4750- 4848	San Andres dolo; Perm.	P 157	34
Gaines	Flanagan	Shell Oil Co's Selma E. Andrews 2, 665 fr el 1984 fr wl of Sect. 2, Blk A-23, PSL Sur. 1 mi ne extension.	5- 5-50	7218	7150- 7218	L. Clearfork li; Perm.	F 284; ½"	39.2
Howard	Vealmoor	Seaboard Oil Co et al's Akin Simpson 1 660 fr n&el of Sect. 45, Blk 32, T-3-N, T&P Sur. 1½ mi s extension.	5-27-50	8035	8015- 8035	Canyon Reef li; Penn.	F 309; ¼"	46
Scurry	Kelly-Snyder	Esperado Mining Co's T. J. McDonnell 1, 467 fr s&el of SW¼ of Sect. 336, Blk 97, H&TC Sur. 1½ mi w extension.	5-15—50	6936	6748- 6936	Canyon Reef li; Penn.	F 627; ¼"	42
		WYOMING—New Oil Field						
Fremont		Sinclair O&G Co's Unit 1, se sw sw 16-28n-93w, in Happy Springs Area. 8 mi w of Crooks Gap fld.	5-16-50	10033	6550- 6575	Muddy sd; U. Cre.	Sw 106; 2 7/8"	37.2
		WYOMING—New Oil Pays						
Converse	Glenrock	Phillips Petroleum Co's Brown-Brubaker 1, sw sw sw 33-34n-75w	4-19-50	7188	7086- 7188	Dakota sd; U. Cre.	P 160; 62 wtr.	34
Johnson	Meadow Creek, N.	Mimi Corp. & Murchison Trust's Federal 3-A, se se ne 34-42n-78w	5- 1-50	4464	4436- 4464	Shannon sd; U. Cre.	F 32; ¼"	....
		WYOMING—Oil Field Extensions						
Johnson	Sussex	Continental Oil Co's Unit 19, nw se nw 18-42n-78w. ½ mi nw extension.	5-24-50	7753	7702- 7720	Lakota sd; L. Cre.	Sw 240	37.2
Weston	Mush Creek, W.	Morton Oil Co-Yellowstone Drlg. Co's Schoonmaker 1, se se se 23-44n-64w. West extension.	5-27-50	4952	4892- 4908	Newcastle sd; U. Cre.	F 200	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing, (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

A prerequisite for any type of visual inspection of the interior of a joint of drill pipe is that all rust, mud and other foreign material be removed and the surface be clean and bright. Sand- or shot-blasting is here being used to insure the desired degree of brightness within the pipe.

Nondestructive Testing Of Drill Pipe

By NORMAN BOWERS

Gulf Oil Corporation

DURING RECENT years, considerable progress has been made in the methods and the equipment used for nondestructive testing of materials. In this article the author discusses available methods and points out the limitations of those that might be used for the inspection of new and used drill pipe. The paper is from the technical program of the Production Engineering Conference of the Gulf Oil Corporation, held in Pittsburgh during May, 1949.

MOST nondestructive tests depend upon a flow or transfer of energy to transmit information concerning the object being examined. This energy may be distributed rather generally, as with a broad X-ray beam, or may be concentrated in a narrow beam, as in supersonic testing. The source and type of energy must be utilized in such a way that their distribution in the subject is significantly modified by defects or variation in properties. Quite frequently, only a very small fraction of the incident energy is affected so that very sensitive detectors of variation in the energy distribution are required to show indications of the presence, nature, or extent of the defects.

It is apparent that some of the theoretically sound methods of nondestructive testing are impracticable, because no suitable source is available to supply the form of energy required. In others, the source is available, but there is no practicable means of coupling this source with the test object so that the energy can be transferred in the desired form. In some proposed tests, defects or variations in properties do not sufficiently influence the distribution of the incident energy. In others, energy losses due to scatter or absorption within the subject being tested are so great that the energy level at the pickup is too low for detection.

Obviously, the most important and critical feature of most nondestructive tests is the pickup unit. The sensitivity needed to detect flaws, particularly in the presence of disturbing effects emanating directly from the energy

source, often cannot be obtained. The difficulties of coupling the pickup unit to the energy field in the test piece are a frequent source of inefficient energy transfer. Further, limitations occur in the selection of range and sensitivity, since highly sensitive detectors can usually be operated only over a very narrow range of energy levels. Lastly, the ultimate sensitivity of the detector is limited by background disturbances, many of which cannot be avoided. Therefore, it is difficult to indicate, amplify, and record in a useful form the low energy output of the pickup device.

New Drill Pipe

The real significance of mill defects found in new drill pipe, such as seams, scabs, plug scores, guide scores, and other common imperfections, has not been fully established. Fortunately, such imperfections are longitudinal for the most part and, being formed while the pipe is hot, they are not usually sharp bottomed and do not lead to fatigue failure in the field. Even deep outside and inside pits have only rarely been known to cause failure. Many drill strings containing the common mill imperfections, some involving as much as 50 percent of the wall thickness, have been run in actual drilling operations. A paper by Thompson and Textor[1] reported that one such string of 4½-inch drill pipe, 5300 feet long, drilled 20 wells (a total of 46,458 feet of hole) in an area where corrosion fatigue failures were common. Twenty-one failures occurred, but not one of them originated at a mill imperfection. A second string, made by the same source, is in service, but data are not yet available.

Other mills report they have supplied pipe containing imperfections for use in mixed strings with results in line with those shown above. Therefore, it appears to be a fairly well founded conclusion that the common types of mill imperfections are of no consequence. Until it has been proved that these imperfections do influence the service adversely, there seems to be no necessity for instituting an elaborate nondestructive setup for testing new drill pipe, either at the mill during fabrication or in the field prior to use. Regular pipe inspection procedures, properly carried out in the mill, should be entirely adequate.

Used Drill Pipe

Failures of drill pipe due to operating conditions have long been a factor in drilling time and costs. These failures, generally twistoffs and washouts, are with few exceptions caused most frequently by fatigue cracks having their origin in corrosion pits or in some cases in nicks due to handling. Preventive measures, rather than detection of incipient failures, should logically be the first consideration. The well-known study made by the Battelle Memorial Institute[2] indicates that drill pipe life could be appreciably prolonged by the use of sufficient drill collars, plastic coatings on the inside surface, inhibited drilling fluids, separate strings for salt beds, fresh water in drilling muds, and cleaning prior to temporary storage.

While the recommended improvements in drilling practice will greatly reduce failures and prolong drill pipe life, it is still desirable to be able to determine when the pipe has reached the limit of its finite life. A suitable nondestructive test to detect and measure cracks and incipient washouts resulting from service conditions would be of great value in this connection. However, it is more or less obvious that having such an instrument is only part of the story. Correlations of the discontinuities indicated by the instrument with serviceability will require more definite knowledge of the influence of the discontinuities on performance of drill pipe than is available at the present time. Most certainly, accurate surveys of the costs directly ascribable to drill pipe failures will have an important bearing on the interpretation of the information developed by a nondestructive technique.

Methods Employed

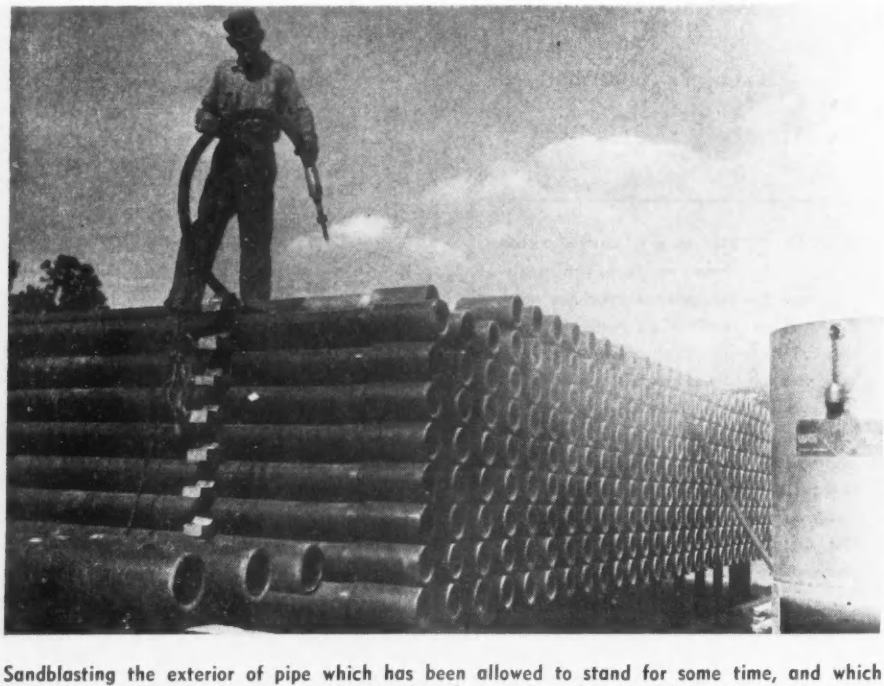
A survey[3] indicated that the various types of nondestructive tests commonly used today are as follows:

- Electromagnetic Induction
- Magnetic Field
- Penetrating Radiation
- Mechanical Vibration
- Mechanical Caliper
- Luminous Energy
- Electric Current Conduction
- Electric Field
- Thermal
- Pressure, Leak, and Penetrant.

The principal of operation of each of the above will be outlined together with the significant potentialities in regard to drill pipe inspection.

Electromagnetic induction tests are based on the principle of inducing electrical currents in a test piece by means of repeated variations in an electromagnetic field. No input contacts are required in this type of test. The induced current in the test piece produces differences in electrical potential, magnetic fields, and heat or temperature gradients. When alternating or varying currents are induced in ferromagnetic materials, the extent of magnetization will depend on the strength of the magnetic field and the permeability of the ferromagnetic material. Pickup units may detect variations in electrical potential distribution, in magnetic field strengths, in temperature, in mechanical force or torque, in losses in the properties of the material, or in some combination of these factors.

This method of testing, using several types of pickup units, such as potential, transformer, magnetic loss, thermal, and mechanical, has been employed quite widely throughout industry as a whole. For a time, two of the well-known instruments employing electromagnetic



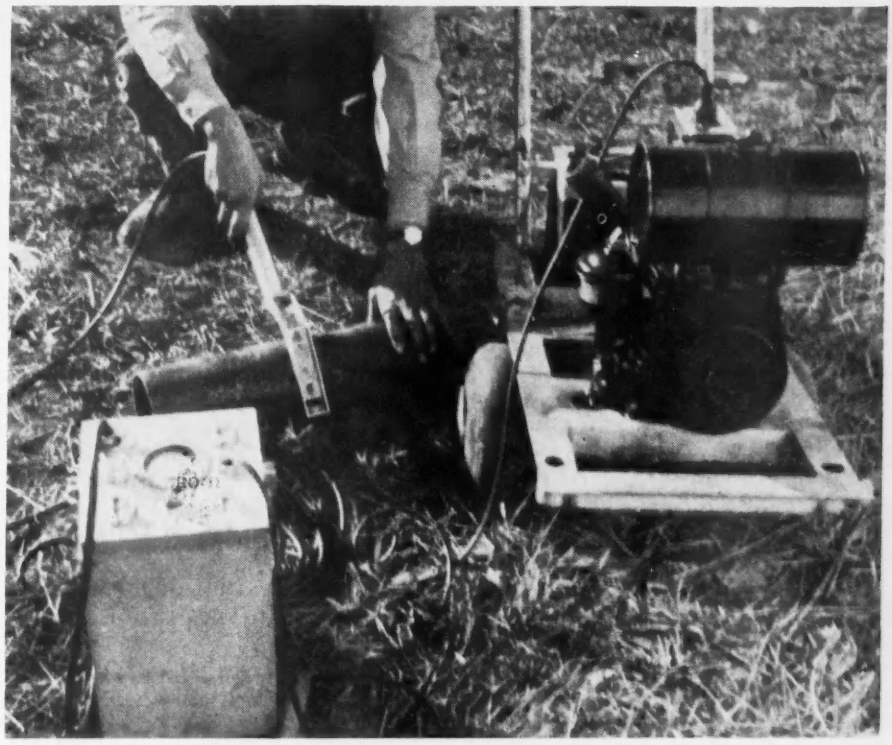
Sandblasting the exterior of pipe which has been allowed to stand for some time, and which has weathered until it is rust-coated, provides clean surface for visual inspection, and permits accurate caliper or other measurements to be obtained.

induction principles were the sclerograph and the cyclograph. The first of these is being utilized in the form of an improved instrument known as the sonoscope for field testing oil country pipe. With this instrument, the energy in the test piece in combination with sonic vibration is modified significantly by mechanical discontinuities, such as cracks, seams, and other flaws, and also by variations in the internal structures due to cold working, uneven heat treatment, and the like. These are shown by changes in the length and intensity of the indications recorded on a chart. Thus far only those internal discontinuities that have penetrated approximately 15 percent or more of the wall can be detected from the exterior of the tube. While it is difficult to differentiate between the nature of the defects, this instrument will detect defects which can be explored later by other methods. At present, each length of pipe must be tested individually on a rack which requires special handling. However, there seems no reason why this device cannot be adapted to inspect the pipe as it is going into or coming out of the hole.

The cyclograph measures changes in hysteresis and eddy currents while the pipe is under load. Core losses are influenced by the magnetic and electrical properties of metal and, therefore, by their physical characteristics which govern these properties. Stress changes produce a marked effect on the magnetic and electrical properties and hence core losses. Therefore, if other factors are constant, changes in stress can be directly related to core losses.

Laboratory tests on drill pipe under torsion loads indicated that increases in stresses were denoted by a sharp increase in core loss. Further, a section which failed in service showed such an increase at some distance from the actual break. Also, a joint that had been straightened showed an increase at the cold-worked region. However, a one-inch hole drilled in the pipe gave only a very slight indication. This indicated that the sensitivity of the instrument was too low to obtain the desired information on all types of defects. It is understood that a new instrument employing a more sensitive detector is being perfected which may possibly indicate various stress patterns resulting from all types of service defects. Such an instrument could probably be used only as the pipe was going into or coming out of the hole as the handling and loading problems would probably make testing of racked pipe impracticable.

It can be said, in general, that electromagnetic induction nondestructive tests offer considerable promise for drill pipe inspection. This type of test has the distinct advantage that it is not necessary to make electrical contacts with the surface of the pipe. Further, scale and corrosion products are of little or no consequence. However, as with other types of tests, considerable investigation will be required before correlation between defects and serviceability can be established.



Detector head, control box and portable generator to provide source of current for field inspection of pipe. Here a tool joint is being examined with high-frequency rays, with results interpreted from variations in the readings obtained.

Magnetic field nondestructive tests measure magnetic properties or conditions in the presence of a steady, unvarying magnetic field, or in a manner which reveals the properties of a particular magnetic state rather than a response to electric currents or varying electromagnetic field conditions. The magnetic field may be established by transient magnetizing forces, but these are not an essential part of the nondestructive measurement. The established magnetic field may be characterized by any one of its properties, such as permeability, remanence, coercive force, flux density, residual flux, stored magnetic energy, etc.

Types of Pickups

Various types of pickups are used to measure the above properties, and thereby reveal flaws in magnetic properties and indications caused by cracks, etc. Such methods have been used extensively to check the surface, mainly of welds, rails, bars, and plates. Magnaflux is probably the best known commercial application of this type for drill pipe. In this the pipe is magnetized longitudinally by a magnetic coil of relatively few turns, energized with direct current. The coil is moved along the pipe while dry, magnetic particles are applied beneath it. The particles reveal the location of seams, cracks, and similar narrow line defects. Wet particles treated to fluoresce under illumination, such as ultraviolet light, are also used.

While the magnetic particle test is highly sensitive to defects which come to the surface of the pipe, it will not reliably indicate discontinuities deeper than approximately ⅛ inch below the surface. Therefore, with present equipment it would be impossible to indicate interior surface defects. However, magnetic particle inspection of the interior surface might be possible if carried out with the aid of a suitable illuminated magnifying optical arrangement. Probably the wet method would be superior. Since the actual depth of the defects cannot be determined, the cost of such an inspection would undoubtedly be out of line with the results obtained. Service defects could be detected, but there would be no correlation between these and serviceability of the pipe.

It is the consensus of major tube manufacturers that magnetic particle inspection will not reveal any important surface imperfections in clean pipe that cannot be found by careful visual inspection. However, this method of inspection might be useful for pipe coated with oil, if such pipe had not previously been properly inspected. This would apply to stock or warehouse pipe.

Penetrating radiation nondestructive

tests are those in which the test piece is subjected to any type of penetrating radiation or beams of high-energy particles, such as X-rays, gamma rays, neutron, ion, or electron beams, etc. The intensity of the penetration is modified by changes within the section being tested, such as defects, cracks, etc. Sensitive radiation detectors, such as X-ray film, fluorescent screens, Geiger tubes, and ionization gauges, are employed to transform differences in the intensity of the invisible radiations into visual images or electrical signals. The differential absorption of the radiation is a function of the material structure and properties, density, mass, thickness, and other properties of the test piece. Scatter, internal reflection, diffraction, and the production of secondary radiation within the piece being tested introduce additional variables.

X-rays, gamma rays, and the like will very sensitively detect wall thinning due to excessive pitting, large area cracks, and washouts. These methods have been successfully employed to check plate thickness, determine densities of fluid flowing in pipe, and indicate and control fluid levels in containing vessels. This is generally not needed for inspection of drill pipe, since wall thinning alone can be determined much more inexpensively by other available methods.

There is, however, one method of radiation inspection, known as the electrograph, which has shown some very interesting results in drill pipe inspection. Drill pipe is inspected by pulling an assembly containing a capsule of radioactive material, a lead barrier, and a sensitive Geiger counter through the pipe to measure the secondary radiation from the wall of the pipe. It is claimed that this device is sufficiently sensitive to pick out and indicate holes, corrosion pitting, seams, grooves, ball cuts, and fine cracks. This instrument also supposedly responds to local stress concentrations, regardless of cause, and hence indicates not only defects which are stress raisers, but conditions of stress in drill pipe resulting from misuse of tongs or slips, and other overloading. Output signals from the Geiger counter are amplified, integrated, and used to produce a permanent record in a recording instrument. Records can be obtained at the rate of about one foot per second so that about 250 joints per day can be scanned. The indications are apparently not affected by scale or corrosion products so that no prior cleaning is necessary.

In common with all other techniques this method does not actually measure the depth of defects, and extensive experience will be needed before the relationship between defects and possible service can be established. So far, tests have been made on racked pipe. While there seems to be no reason why pipe cannot be checked while standing in the derrick between trips, considerable development is needed before this device can be used for checking pipe as it is being run into or out of the hole.

Vibration Methods

Mechanical vibration non-destructive tests are based on the principle of the establishing of vibrations within the piece being tested and their detection by a suitable means. The vibration may be natural frequency oscillations (as by hammer blow) or forced sonic or supersonic vibrations. It is well known that high frequency vibrations tend to travel in beams and may be transmitted, scattered, or reflected locally by defects or discontinuities.

The procedure of striking the test piece a blow with a hammer and listening for the "ring" or sound of the natural vibrations has been used since ancient times to determine the soundness of castings. This method is employed in one mill at the present time to detect laminations in welded pipe. Many techniques now used in vibration testing employ some improvement of this old hammer method. Generally, these have an electromagnetic pickup unit which detects flaws by phase differences in vibration.

Supersonic vibration methods have been used quite successfully in detecting flaws in casings, plates, bars, structures, etc. While there is no commercial equipment presently available for testing drill pipe, the nature of fatigue cracks and corrosion pits is favorable for their detection by supersonic methods. Special arrangements of the transmitter and detector will be necessary, but it is believed that this can be accomplished satisfactorily. More sensitive means of evaluating local defects are needed at present. This could undoubtedly be done by means of higher frequencies than are now commercially used. Even with the wave length in present day supersonic equipment, large fatigue cracks can be detected. Therefore, this type of test might be used for a fast, rough check on pipe laid down on a rack without the necessity of extra handling.

Supersonic vibration methods of testing drill pipe appear to offer excellent possibilities for the future. Testing could be arranged while the pipe was making a trip or while laid on a rack. Furthermore, with suitable sensitivity, this technique could be used to determine the extent of discontinuities detected by other methods.

Mechanical caliper or gauge nondestructive tests measure the dimensions of test objects through probes and feelers. In most cases the method involves a means of detecting dimensional differences quickly and sensitively, often with automatic indication or sorting of acceptable and rejectable pieces.

Mechanical "Go" and "No Go" calipers are widely used to detect changes in the outside diameter of pipe. Devices for detecting and locating corrosion pits and incipient washouts on the inner surface of drill pipe are also commercially available in form suitable for lowering into the well or for pulling through pipe on a rack. Generally, these devices have retractable feelers or prongs, arranged radially so as to contact the inner surfaces at a series of points around a circumferential ring. The feelers may be pushed outward to contact the surface and withdrawn between measurements by quick acting magnetic or pneumatic motors. The maximum outward displacement of each feeler is recorded by an attached slide wire resistance or other electrical device which transmits the deflection signal to a multichannel recorder.

Local pits and wall thinning are revealed by variations in the deflection record for the feelers in contact with these locations. Washouts, particularly those which extend far enough to be recorded by several feelers, are revealed by large deflections. However, pitting often occurs in the form of small, deep pin holes which are difficult to detect with mechanical calipering devices, particularly at any reasonable speed. Further, fatigue cracks that are fairly long but not opened up cannot be detected by this method. While surveys made by this type of nondestructive test produce useful information concerning general interior corrosion losses, a great deal of necessary information regarding the serviceability is not developed.

Luminous energy nondestructive testing is the glorified term applied by others to the well-known procedure wherein visible light is used to illuminate test pieces which may be scanned by eye or by light-sensitive devices, such as photoelectric cells. Ordinary visual inspection and that with optical aids, such as telescopes, microscopes, mirrors, and lenses are included in this class.

Simple mirrors and lenses to improve visual inspection have been used for a long time. "Tuboscope" and "Borescope" are perhaps the best known commercial methods now used for inside surface inspection, although other modifications have been developed and used. In this type of inspection, the surface must be thoroughly clean. Large corrosion pits and the like can be detected, but fatigue cracks are virtually impossible to see. This type of testing may,

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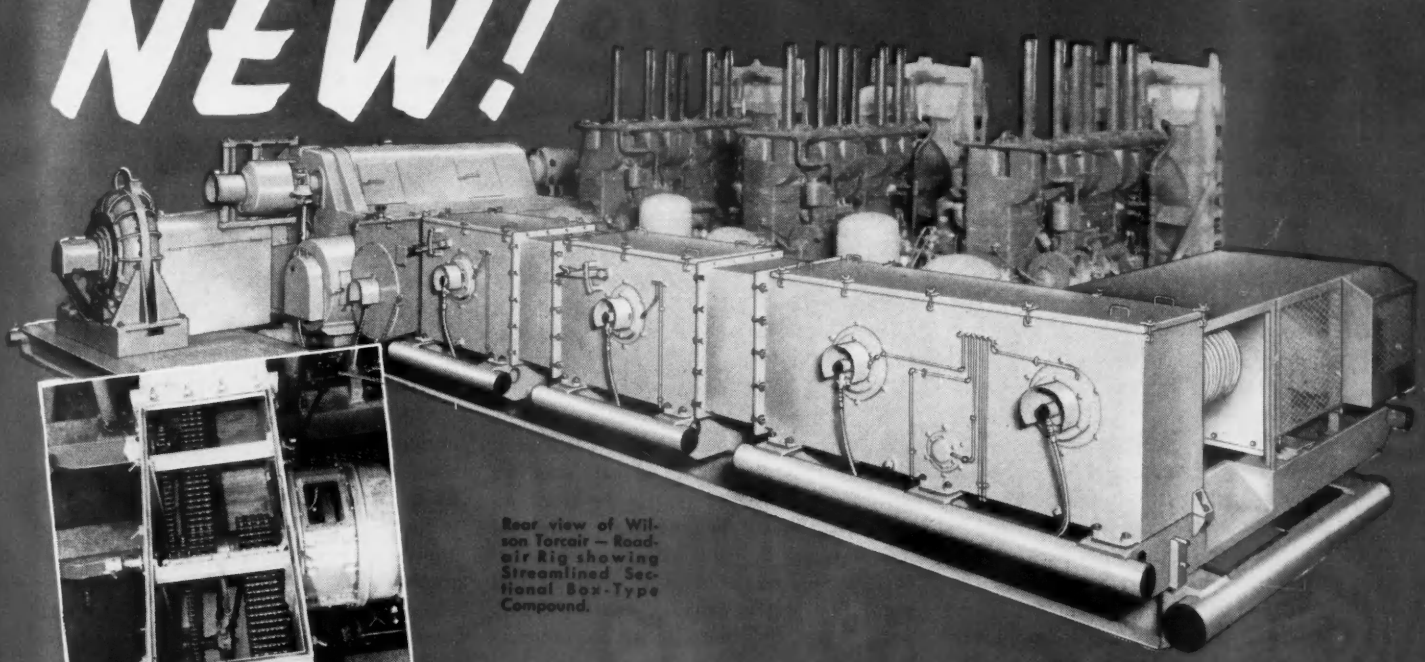
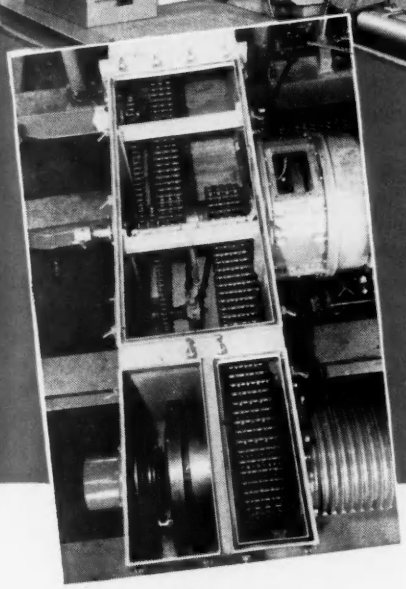


Rear view of Wilson Torcair — Roadair Rig showing Streamlined Sectional Box-Type Compound.



Top view of Sectional Compound with oil tight lids removed.

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on occasion, be of value in inspecting used drill pipe.

It might be mentioned in passing that a few years ago, one of the major pipe manufacturers "tuboscoped" every joint of drill pipe before shipment. This method was discarded after sectioning of hundreds of joints showed that the imperfections detected were well within the tolerances of the specifications, since it could not indicate the depth of defects, such as seams.

Electric current conduction nondestructive tests utilize a flow of heavy electric currents from an external source through the test piece by means of direct contacts or electrical connections. The current flow produces differences in electrical potential, magnetic fields, and heat or temperature gradients which may be influenced by defects or variations in the material being tested.

Using various types of pickup units, electric current conduction has been applied to a wide variety of different equipment. Large voids and significant discontinuities in physical properties may be reliably detected. This method is not suitable, in general, for detection of seams, laps, and similar defects which introduce no measureable volume of void or significant insulating discontinuity. When seams or laps occur during piercing and rolling, the two surfaces of the material are usually tightly pressed together, forming thousands of points of relatively good contact and tending to break up any oxide or inclusion films which happen to be present initially. Hence, flow across the discontinuities occurs almost without interference.

Cracks which pass part or all of the way through the wall thickness of the drill pipe could be detected by this method of testing with suitable arrangements of electrodes and appropriate detectors. However, the surface must be clean and free from scale or corrosion products. Furthermore, small cracks produce only small signals which are hard to amplify and record. However, only recently useful methods of detecting and recording low voltage, d.c. signals have been vastly improved. This may eventually increase the value of electric current conduction for nondestructive testing of drill pipe. At present, however, this type of testing does not appear to be promising for full length joint inspection of either new or used pipe. It may have some application for small local checks on the extent and depth of fatigue cracks, revealed by other methods, since a small area might be cleaned adequately by any one of several methods.

Electric field nondestructive tests establish an electric (potential) field within the test piece or between the test piece and external conductors, under conditions in which magnetic effects can be ignored. The test piece or conditions within it may influence the electric field strength or the breakdown of the electric field so that an electric current passes.

This method has been used for checking paper, thin sheets of metal, electrical conductors, and the like. However, no useful method of applying this type of testing to drill pipe has been proposed and it does not appear to have any future possibilities.

Thermal nondestructive tests depend upon a flow of heat into a test piece and the measurement of the associated temperature conditions. Heat may be introduced into the test piece from an external source through direct thermal contacts, or intermediate heat conductors, or may be developed within the test piece by electric current heating, magnetic losses, or other energy transformations.

This type of testing can be used for checking wall thicknesses of various materials, for detecting flaws in welds, tubes, bars, and plates. Because of their time-consuming nature and the difficulty in detecting and interpreting indications due to flaws, thermal nondestructive tests offer little immediate promise in drill pipe testing where wall thickness measurements are not a problem.

Pressure, leak, and penetrant nondestructive tests are those in which there is a flow into or through defects and discontinuities in a test piece. They reveal defects by visible evidence of fluid leaks, by loss of pressure, or other indications.

A long history is associated with nondestructive tests in which pressure or vacuum is established within a test piece, or differential pressure is established across walls of a test piece, and differences in pressure owing to leaks are measured. A great many patents have been issued in this category. However, it does not appear likely that this method of nondestructive testing will reveal defects other than cracks that have progressed through the wall. Some drillers now apply full mud pressure to each joint before lowering it into the hole to detect washouts.

Summary

The foregoing covers the well-known methods of nondestructive testing. Some of these are now employed and others offer future promise for drill pipe inspection. A few have nothing to offer for this type of service. In many cases, improvements are needed before the particular method is practicable. In others, extensive tests are needed to correlate the measured properties and the serviceability of the drill pipe. Unfortunately, some of the methods do not detect all of the flaws which may be significant.

Many of the methods could be used for inspection of new drill pipe in the mill, but the consensus is that careful mill inspection will eliminate mill imperfections. Any one of several of the methods might be used by the mill to check the extent of interior defects found by visual inspection. Nondestructive testing of new drill pipe in the field is needed only when such pipe has not been properly inspected in the mill prior to application of coating oil.

While none of the present types is entirely satisfactory for inspection of used drill pipe, promising methods seem to be those employing electromagnetic induction, penetrating radiation, and supersonic vibration. Each of these methods has the added advantage that cleaning of the pipe is not necessary as scale and corrosion products do not influence the indications by the pickup units. It is said, however, that the cost of penetrating radiation type of testing is too great at present to allow it to become popular.

The other types of nondestructive tests do not appear to hold much promise for the future except as supplementary tests. Electric current conduction tests could be used to check the extent of cracks revealed by other methods. Mechanical calipering and magnetic field methods will not detect fine, deep pits or cracks in the interior surface. Such discontinuities might be found by magnetic particle inspection in combination with an illuminated optical viewer, but the costs in this case would probably be prohibitive, especially since the extent of the discontinuity could not be established.

The measures that are known to minimize drill pipe failures are considered more conducive to reduced drilling costs than testing for incipient failures with best known available methods, because the interpretation of the indications obtained in terms of drill pipe serviceability has not yet been developed to a reliable degree. Consequently, as stated repeatedly herein, there still remains the problem of judging when the pipe has reached the end of its useful life.

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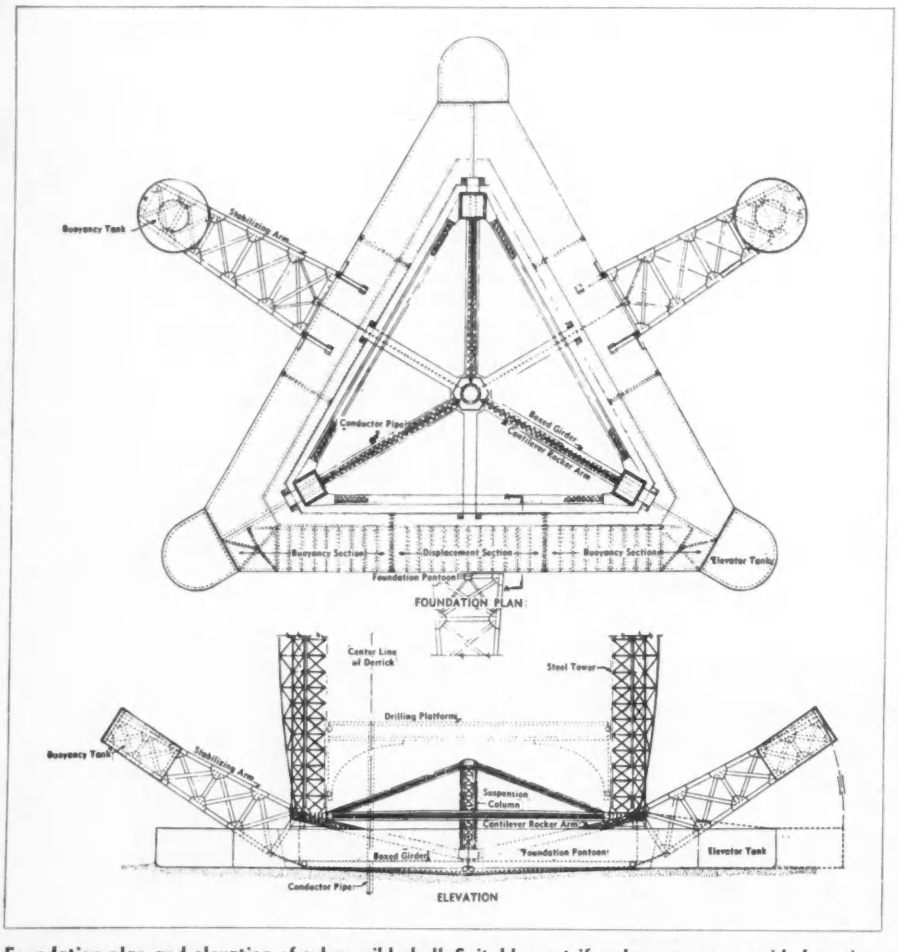
- The rig must be able to safely withstand the severe loading of an actual wind velocity of 125 mph and wave action of 50 feet.
- The rig must have leveling means to permit exploration operations on a maximum 10 degree ocean floor incline.



Foundation plan and elevation of submersible hull. Suitable centrifugal pumps are provided to eject ballast from the floodable compartments. The stabilizing tanks lie in a horizontal position on the ocean floor during drilling operations providing a broad base for the rig and superstructure, thus increasing stability.

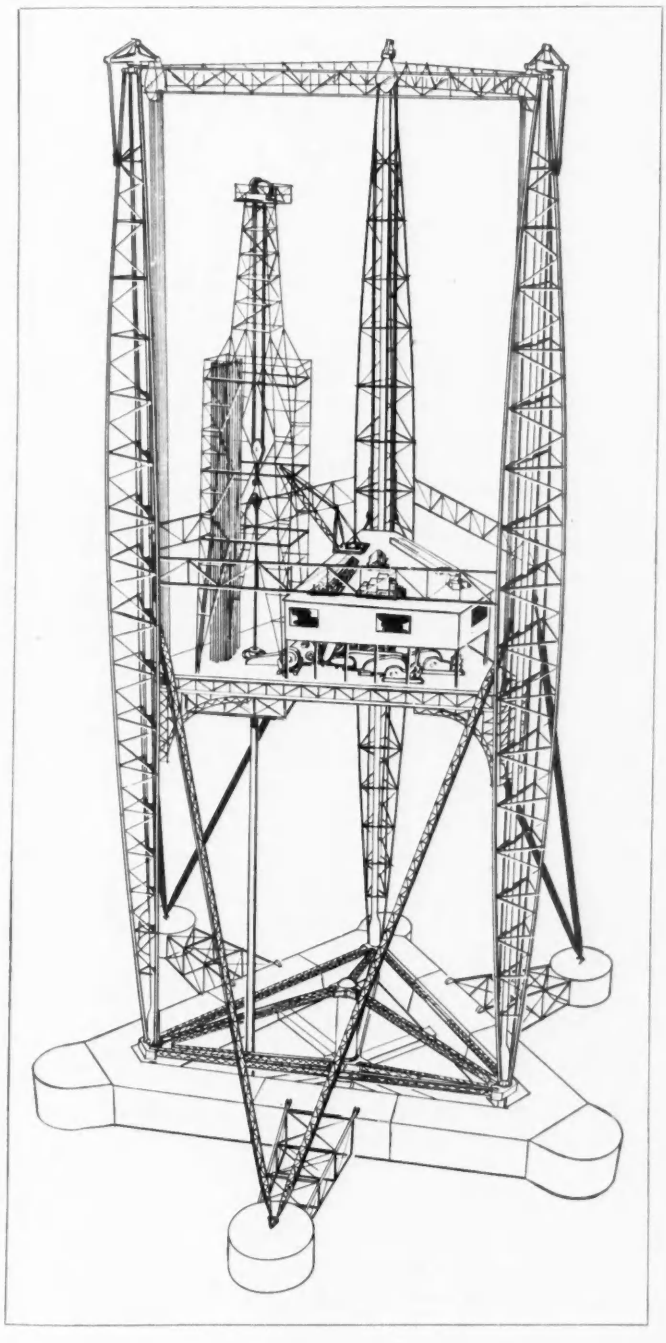
Design Details

As can be seen from the illustrations, the mobile exploration rig basically consists of three elements: a triangular submersible barge or pontoon which can be flooded with water so that the barge may be sunk and rested on the ocean floor; a buoyant triangular platform or deck carrying all drilling equipment, barge controls, living quarters, etc.; and three supporting towers each 450 feet high and positioned at the corners of the equilateral triangularly shaped buoyant drilling platform and connecting the platform to the submersible pontoon.

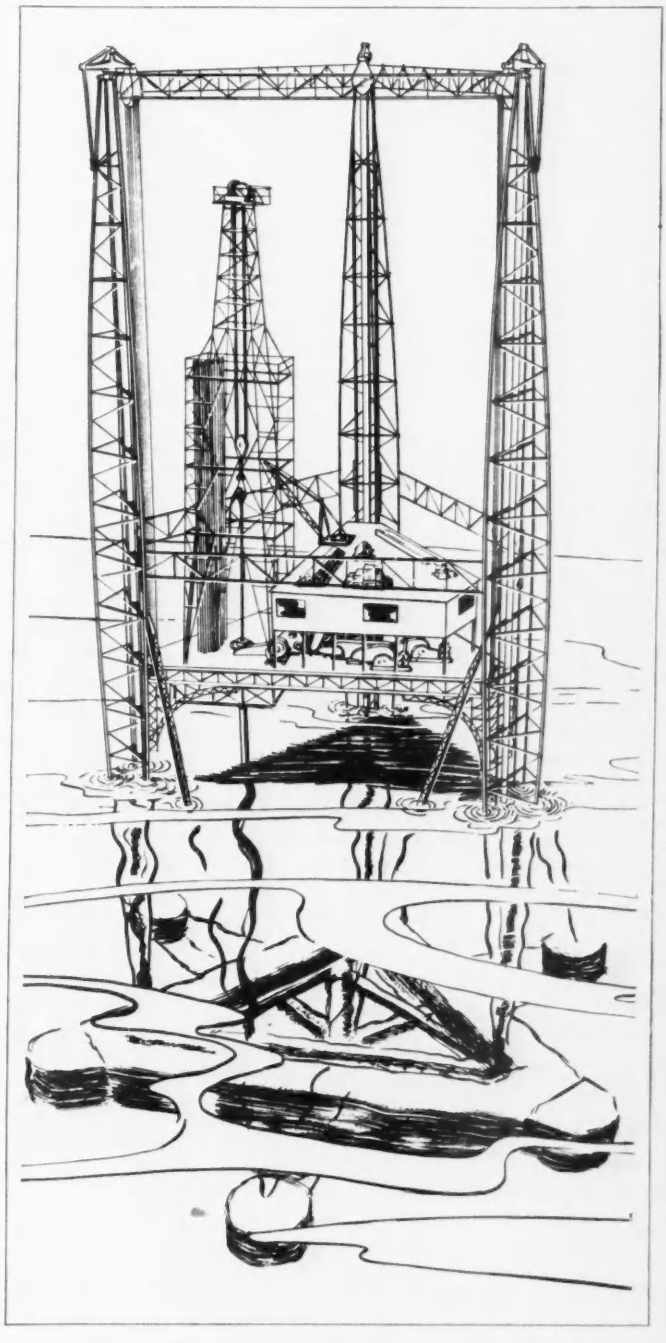
The drilling platform is suspended from the tops of towers by means of conventional inverted crown and traveling blocks. This permits the platform to be raised or lowered within approximately 20 feet of the top or bottom of the masts and therefore permits the drilling platform to be placed in any desired position, depending upon the depths in which the unit is operating. The drilling platform, as designed, consists of three levels, with a cage for blowout preventers hanging below. The first, or drilling level, holds rig, pumps, tanks and pipe racks. The second level has quarters for the crew, storage space, and personnel and operating facilities. The top level is really the reinforced roof of the crew's quarters and is planned as a storage area. Plans call for a 1600-horsepower diesel electric or standard power rig capable of drilling to 16,000 feet with 4½-inch outside diameter drill pipe. A 16- x 26-foot base, 136 feet high, double bulge derrick with crown block capacity of 800,000 pounds will be employed. The use of the double bulge derrick will permit racking of 180 thribbles of 4½-inch O.D. Range 2 drill pipe in each bulge. This provides suffi-

cient racking capacity for 16,000 feet of drill pipe and/or casing. The corners of the drilling platform are provided with suitable slide shoes which embrace guide rails on the tower assemblies so as to secure the platform and towers to one another and still permit vertical movement of the drilling platform. The three supporting tower columns are constructed of high tensile strength nickel steel and are each designed to support a maximum load of 1500 tons or a total load capacity of 4500 tons.

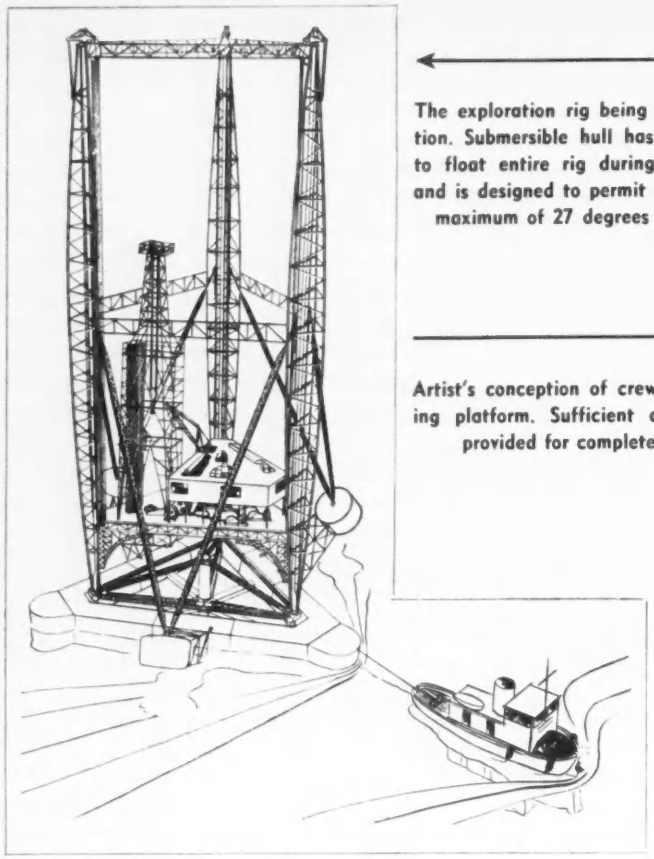
The submersible hull is a triangularly-shaped pontoon assembly, approximately 250 feet on a side, with sufficient buoyancy to float the entire exploration barge. Suitable centrifugal pumps are provided to eject ballast from the floodable compartments when raising the foundation hull or when trimming the rig. Control means are provided to create relative buoyancy at critical points of the hull area when the hull is bottomed whereby an angular lifting action on the hull will be effected to break any suction grip of the hull in muddy or sandy bottoms. It will be noted that the structural spider-like assembly of cantilever and suspension members used in the submersible hull is below the plane of the floodable compartments with the hub at the geometric center of the equilateral triangle formed by the supporting towers. This provides a convex shaped assembly when the hub center rests on the bottom. Levelling of the rig is accomplished by hydraulic jacks at the base of each of the three tower columns. These jacks provide a synchronized levelling action and permit drilling in localities where the ocean



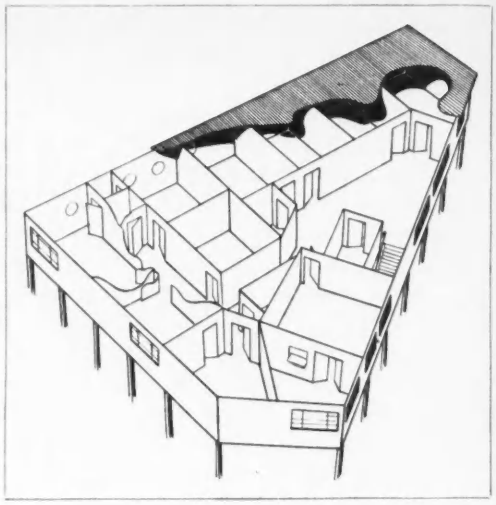
Artist's perspective scale projection from engineering drawings of the barge, which is capable of drilling in waters up to 350 feet deep.



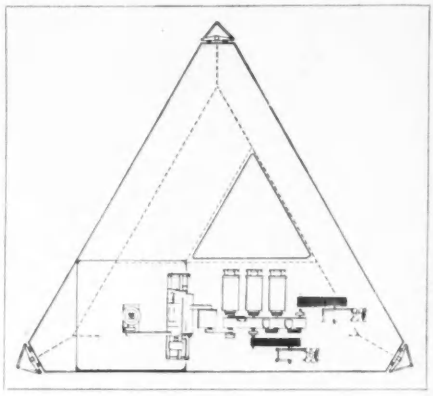
During drilling operations, drilling platform is raised to point above surface of water, usually 35 to 45 feet, to eliminate wave danger.



The exploration rig being moved to new location. Submersible hull has sufficient buoyancy to float entire rig during moving operations, and is designed to permit rig to be tilted to a maximum of 27 degrees without capsizing.



Artist's conception of crew's quarters on drilling platform. Sufficient accommodations are provided for complete drilling crews.



Plan view of drilling platform showing location of drilling rig equipment. It is designed for use with either a diesel electric or standard internal combustion engine hookup.

floor is inclined up to a maximum of ten degrees.

Hinged stabilizing arms containing floodable compartments extend from the middle of each side of the triangularly shaped submersible hull assembly. These stabilizing tanks are flooded with water and lie in a horizontal position on the ocean floor during drilling operations. In effect, they provide a broad base for the exploration rig and insure the necessary stability when the hull is bottomed on the ocean floor. Design calculations show that rig can be inclined to a 27-degree angle without capsizing. This is equivalent to a wind force of 72 tons exerted on the exposed area of the structure.

Operation of the Rig

It is important to remember the rig is strictly for exploration operations: to locate oil fields on and beyond the continental shelf in waters from 50 to 350 feet in depth; to determine effectively the potential production of such pools by conducting production tests; and, to define the limits and reservoir characteristics of the oil fields when discovered. Once the oil fields have been discovered and completely defined, it will be necessary to employ some other means for the further development and production of the structure. At the present time plans are being perfected for a special type of production platform for use when producing wells are completed.

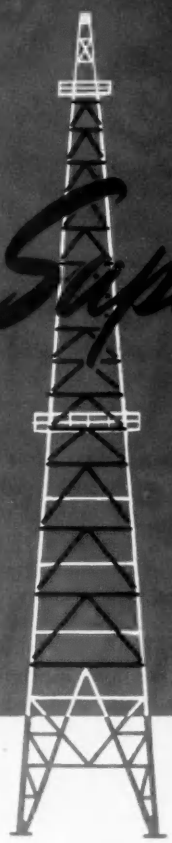
The mobile exploration rig will be constructed and completely assembled at a shipyard. It will be fully equipped in all respects to operate at any selected location without dismantling or rebuilding on the location where each exploration well is to be drilled.

The operating procedure for the mobile exploration rig is simple. During moving operations all ballast water will be ejected from the submersible hull, the hinged stabilizing arms folded up, and the entire rig towed to the next drilling location by means of the buoyant hull. During this moving operation, the drilling platform rests on the hull. Upon arrival at the new location, the compartments of the submersible hull will be flooded slowly. This will cause the foundation pontoon assembly to submerge, causing the buoyant drilling platform to come in contact with the water. During this operation, the stabilizing tanks float on the surface and provide the necessary stabilizing action until the drilling platform comes to rest on the surface.

Once the drilling platform rests on the water surface, it provides the stability to the rig during raising and lowering operations. After the foundation pontoon assembly is bottomed, the towers are levelled by means of the hydraulic jacks, and the stabilizing tanks flooded, causing the stabilizing arms to rest on the ocean floor. The drilling platform is then raised by means of the platform hoist to a point above the wave action, usually 30 to 40 feet above the surface. The platform is securely locked in position by means of automatic locking devices and drilling operations may be started immediately.

Economics

Detailed estimates show that the cost of the mobile exploration barge capable of drilling in waters from 50 to 350 feet, completely equipped with all drilling equipment, drill pipe and supplies, will be in the neighborhood of $1,250,000. This is comparable to the cost of the offshore platforms now being used for exploratory work in the Gulf of Mexico. However, the designers claim that the elimination of rigging-up and tear-down time and expense, coupled with the versatility and mobility of the proposed rig will save at least 60 percent of the total drilling costs, and will permit exploration activity at a cost not much greater than that of comparable drilling operations on land, in waters whose depth heretofore were thought to prohibit successful exploratory work.



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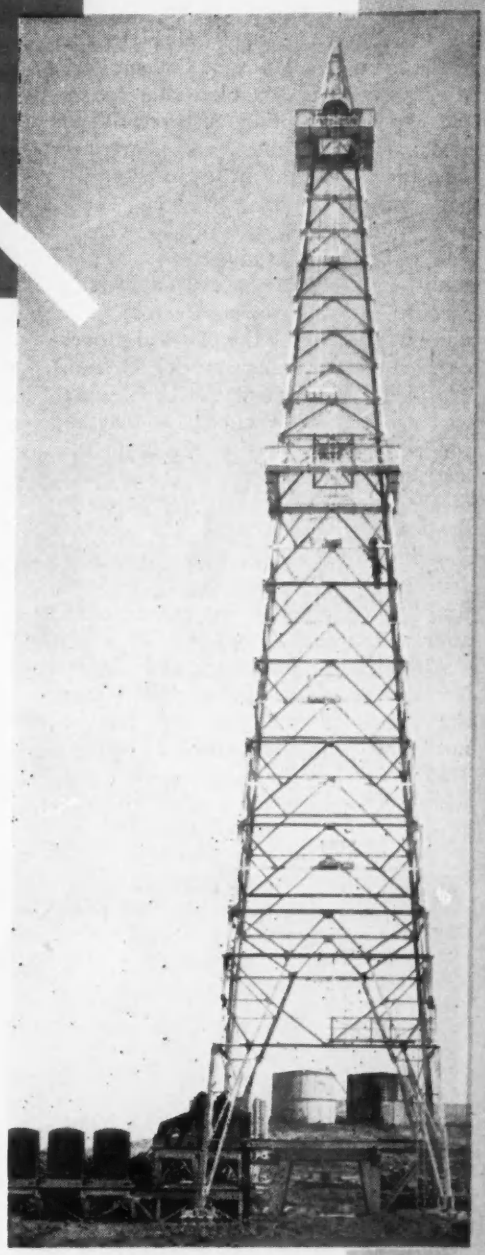

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Experiments in

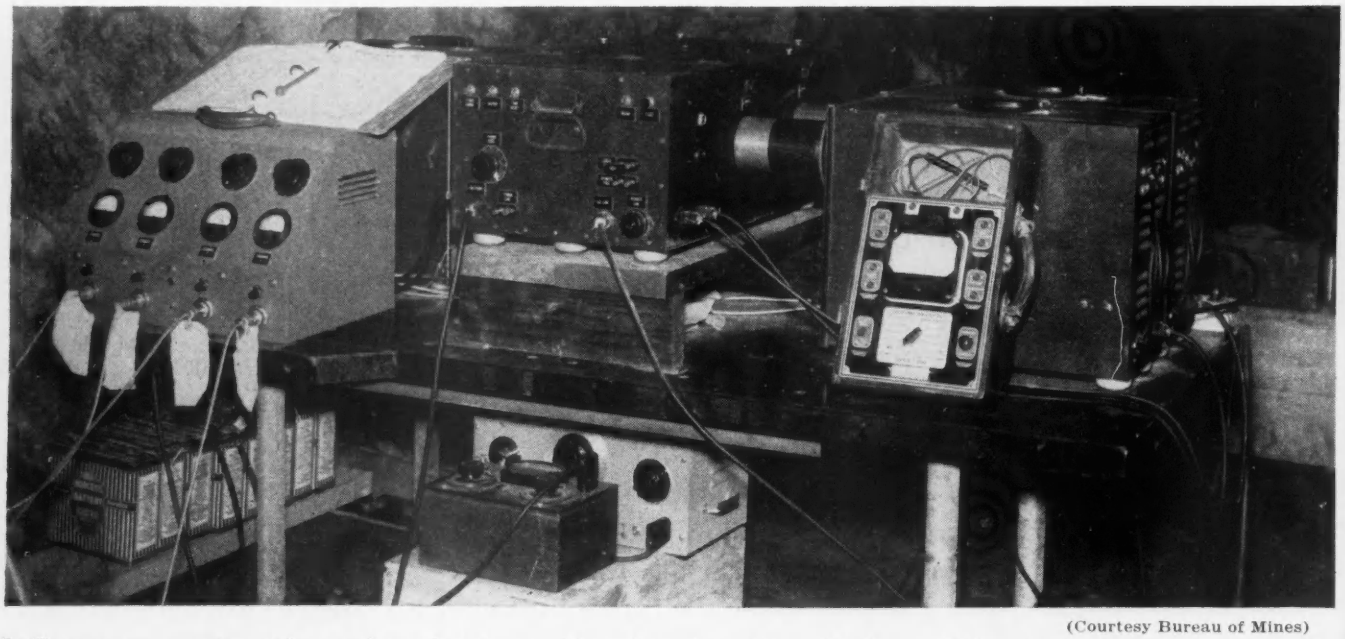
Oil-Gas Well Shooting

IN CONNECTION with its secondary recovery program the Petroleum and Natural Gas Branch, Bureau of Mines, cooperating with the Applied Physics Branch of the Mining Division of the Bureau of Mines at College Park, Md., last year undertook a study of oil- and gas-well shooting. A threefold approach to the problem was started to determine how and why an explosive fractures oil- and gas-bearing rocks, thereby increasing the productivity of shot wells: (1) a study to correlate the results of shooting with the physical properties of the rocks affected; (2) a survey to determine the physical properties of the oil-bearing rocks obtained from fields throughout the U. S. where well shooting is practiced, so that any correlations developed by the first study may be applied directly to the shooting of oil and gas wells; and (3) an analytical study of present oil- and gas-well shooting practices in every producing area and the results as measured in terms of production rates before and after shooting.

Although the chemistry and physical behavior of explosives are well known, the effects of explosives on rocks are not known with any degree of exactness. Unfortunately, oil and gas operators can measure the effect of a shot only indirectly through increase in conductivity of the well and to some extent in terms of the amount of material cleaned from the well after the shot. Direct measurement, or examination of the fractures that have caused the increased conductivity in wells, is not possible. To improve the empirical methods now used in designing shots for oil and gas wells, it will be necessary to explore the fundamental relationships governing the fracturing of rock under well-shooting conditions. Fortunately, the Applied Physics Branch of the Bureau has been working during the last few years to determine the behavior of rock when subjected to dynamic or shock loading and has developed techniques of measuring the strain produced in rock by the shock wave resulting from an explosive detonated within the rock. The instrumentation techniques and knowledge of rock behavior have permitted an experimental approach to the problem of oil-well shooting that promises a direct correlation between the effects of different explosives (or between varying the methods of loading, tamping, and detonating any one explosive) and at least some of the physical properties of the rock as determined by laboratory measurements on core samples.

The experimental program includes shooting small-diameter holes drilled to shallow depths in a sandstone sufficiently thick and with suitable lithologic properties, with gauges mounted around each experimental shot hole to determine the strain produced in the rock by the shot. These gauges provide a means of judging the extent of fracturing to be expected, while injectivity tests on the holes before and after shooting would show the increased conductivity resulting from the shot. To test the validity of this approach, a series of tests was completed last year on a lease 3½ miles from Franklin, Penn., where a 50-foot section of the Homewood sandstone (Pottsville group of lower Pennsylvanian age) occurs under a few feet of overburden.

Four types of tests were made. In the first type, termed "linear array tests," eight holes three inches in diameter were drilled 25 feet into the sandstone at intervals of 20, 10, 5, 5, 5, 10, and 20 feet. Strain gauges were cemented into the first four holes, and successively larger shots (three-fourths to 96 pounds) of 60 percent high-velocity gelatin dynamite were detonated in each of the four remaining holes, starting with the hole farthest from a strain gauge and continuing until a charge large enough to break a strain gauge had been detonated



(Courtesy Bureau of Mines)

Oscilloscope-camera equipment for recording rock strain caused by explosive detonation used in Bureau of Mines tests in shooting oil and gas wells.

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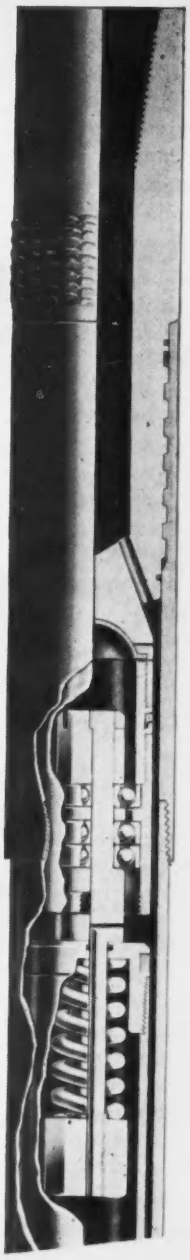

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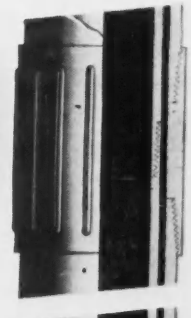

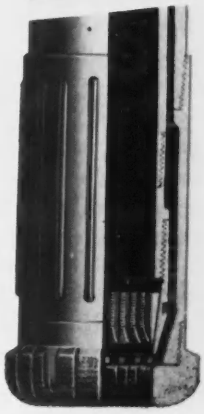

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The model for diamond core barrels

Barrel Patent No. 2,490,512

in the shot hole nearest a strain gauge. From these tests, excellent correlations of strain versus both distance and charge weight were developed for the exposive used and the breaking strain of the sandstone were determined. From 120 strain-gauge records, the following straight-line relationship was found:

$$e = KY^n = K\left(\frac{\sqrt[3]{w}}{D}\right)^n$$

where

e = peak strain, microinches per inch,
K = 12,000
n = 5/2.
w = weight of explosive in pounds
D = distance from the shot in feet
(K and n are constants for rock and explosive in use.)

This type of test offers an excellent means of comparing different explosives.

In the second series of shots (termed "crater tests"), a fixed weight of explosive (60 percent gelatin dynamite) was detonated in five 6-inch diameter holes ranging in depth from 7.5 inches to 10.25 feet. Strain gauges mounted in three-inch diameter holes around and below the explosive charges were utilized to measure the energy transferred to the rock. Before drilling, the sand surface was exposed by removing all soil and clay. Each charge occupying six inches of hole was tamped with damp sand to the surface, thus stemming each explosion with a column of sand ranging from 1.5 to 117 inches. After the shots, the sizes and shapes of the craters formed were measured. It was found that, from a depth of cover ranging from three inches (interpolated) to almost ten feet, the energy transferred to the rock was at a maximum when the depth of burial was 2.25 feet. From 20 strain-gauge records, the previously derived Crater law was verified. Although some of the conclusions must await a more complete analysis of the data, it appears that data obtained on rock fracturing from the shooting of shallow holes (depths on the order of 25 to 75 feet) may be applied to the oil well shooting problem.

In the third series of shots (termed instrumentation shots), the suitability of gauges (three strain gauges and two accelerometers) of different design for measuring stresses set up in rock was compared directly in each of three similar patterns using two explosives: 60 percent gelatin dynamite and liquid nitroglycerin. From these shots it is clear that the accelerometers used are not suited to quantitative measurements of shock-wave effects in the frequencies generated close to the shot, whereas both types of strain gages utilized gave clear records from which accurate measurements can be made.

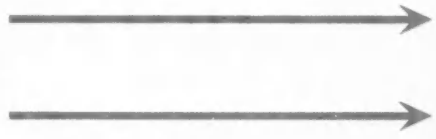
In the fourth series of tests, each of three shot holes three inches in diameter and drilled 25 feet into the rock (average depth, approximately 32 feet) was offset by four strain-gauge holes at distances ranging from 2½ to 20 feet. Before these holes were shot, injectivity tests using water were run on the lower 15 feet of sandstone exposed in the well bore. The lower six feet of each hole then was shot, and injectivity tests were rerun to determine the effect of the shot on the conductivity of the shot hole. Three different explosives were used: 40 percent straight dynamite (chosen as the lowest-powered explosive used in rock breaking), liquid nitroglycerin, and solidified nitroglycerin. The two nitroglycerins were so detonated as to insure maximum rate of detonation and were chosen as the most powerful explosives available. The purpose of these tests was not so much to compare explosives as to define the limits between which other explosives should fall in terms of both strain produced in the rock and changes in conductivity of the holes. Analyses of these tests showed that the injectivity rates were increased by the shots 657, 580, and 673 percent, respectively.

From the data obtained on these preliminary tests, it will be possible to work out a future program of experimental shooting that can be expected to provide valid relationships affecting the design of shots for oil and gas wells to insure maximum increase in conductivity of the well (maximum fracturing), provided the physical properties of the oil and gas-bearing rocks are sufficiently well known.

Tests developed and standardized by the Applied Physics Branch permit the determination, on diamond-core samples, of the following rock properties: Compressive strength, flexural strength, impact toughness, abrasive and scleroscope hardness, modulus of elasticity, modulus of rigidity, specific damping capacity, and longitudinal bar velocity. In addition, an impact test to determine the breaking strain under high-speed dynamic loading of disks cut from a core sample is being developed with the expectation that this, or similar laboratory tests performed on a core, may provide criteria for shot design for the formation or well cored.

ACKNOWLEDGMENT

Excerpt from Bureau of Mines Report of Investigations 4654, February, 1950.



With this issue and on the opposite page, WORLD OIL inaugurates a series of cartoon drawings — *Graphics* — portraying abuses of rig equipment, adding, where needed to drive home the point, a second sketch illustrating a better way to get the job done.

SAFETY TRAINING By Specific Practice Problems

Part 4

Drilling Rig Safety—Pipe Stabbing, Racking and Spinning Practice

By J. I. POWELL, Consultant

ONE outstanding contributor to oil well drilling accidents has been the inability on the part of individual crew members, and the crew as a whole, to recognize and be governed effectively and safely by accident producing circumstances. Crews, on the other hand, will not have the true ability to recognize such circumstances unless they have either personally experienced them, or have been trained through the medium of applicable and factual information.

To be able to use one's imagination in visualizing possible accident producing circumstances that could endanger one's personal safety, a person must first have had ample related experiences and have absorbed their true meaning. One does not have to sustain an actual injury, however, to be able to understand the accessory contributors to accident occurrence. The constructive side of the picture is, however, that the man who has been seriously injured always has a constant reminder of the attending conditions that contributed to his injury. The man who has not yet sustained a serious injury could learn much from the man who has already learned his lesson the hard way.

The objective in inspiring drilling crews to think and work safely would fall far short of its goal, however, if the entire burden of safety training were placed only on those who have been critically injured. Those men, of course, could provide emphasis in a way of which no one else would be quite capable. They can and have contributed much to the progress that has been made in preventing accidents on drilling rigs. There is still ample room for progress. Those unfortunate experiences should be utilized and made available to more drilling crews who every day have to expose themselves to the same determining conditions through which other men have been fatally injured.

It is true that the secondary contributors associated with the occurrence of some drilling rig accidents are complex and difficult to understand. There are others, on the other hand, that require little effort. However, all of them . . . the complex, difficult and the simple . . . can be better understood through concentrated study. This study should not necessarily be confined to the accessories of occurrence for a single accident, but of many accidents of a parallel nature; that is, those that have occurred within the same practice, but taken from experiences of various drilling contractors.

It does little toward helping the drilling industry as a whole for a drilling contractor to have experienced a serious accident within his operations, and have found a solution which should normally prevent its recurrence, without having made the solution available to others. It is through such a manner that valuable life-saving information gets isolated and becomes unproductive in the sense of its fullest potentiality. This isolation of knowledge is the reason why some drilling rig crewmen are unable to recognize the same accident-producing circumstances that others have already experienced.

It remains to be said then, that for accident prevention to reach its highest hoped-for attainment, everyone concerned will have to cooperate.

The mental faculty which individual rig crewmen need most is that which enables them to instantly recognize accident-producing circumstances.

The same set of circumstances as a group that contribute to an accident are not always the same in all other accident occurrences. Some of the elements of cause, however, are usually common to all accident occurrences. The point is then that if some elements of cause are common to all accidents, it should be highly important that training be concentrated on overcoming, correcting or solving the reason for those elements of cause existing.

In a very unusual accident investigated, 2 crewmen received minor injuries. One sustained caustic burns on his face and burns in an eye when drill mud was blown into his face, and the other sustained injury to his hand when ice plugs were blown from the open end of the drill string extension in rotary.

One man was wrapping the spinning chain around the extended tool joint box and the other was standing nearby waiting for the next pipe stand to be stabbed into the box. These men had not the slightest idea that ice plugs were going to be blown out of the open end of the pipe string. A few seconds previously each had had his head directly over the open pipe string end.

During the past winter a drilling rig crewman was fatally injured as a result of being struck in the head with ice blown from the drill string.

The fact that a man could be fatally injured under similar circumstances that produced 2 minor accidents which had already been investigated, provided added emphasis to the importance of the attending facts of the first case.

Before going further, however, let everyone set the fact in their minds that the 2 men who received minor injuries did not anticipate such a happening. On the same basis it can be assumed that the man who was fatally injured did not anticipate such a happening. An effort will be made to answer the question: "Why didn't they anticipate these occurrences?"

This type of accident was entirely new to those men. They were working in a colder climate than they had previously worked during the winter months. No safety bulletin, designed to caution men on periodic hazards such as this, had been posted on their dog house bulletin board. The man who was, perhaps, in a better position and more qualified in the technicalities of preventing accidents and developing bulletins had not heard of such a happening before.

It was winter and the temperature

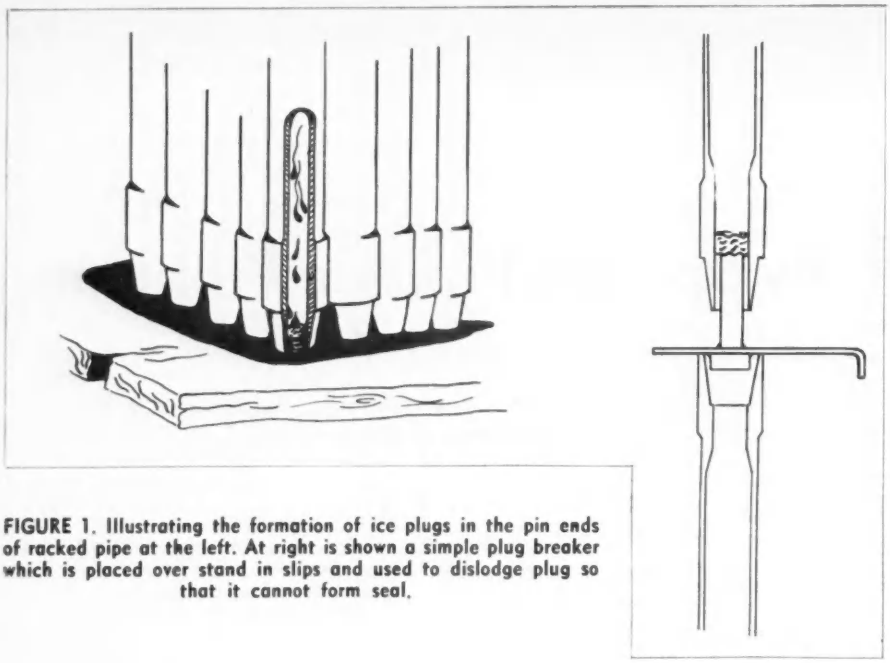


FIGURE 1. Illustrating the formation of ice plugs in the pin ends of racked pipe at the left. At right is shown a simple plug breaker which is placed over stand in slips and used to dislodge plug so that it cannot form seal.

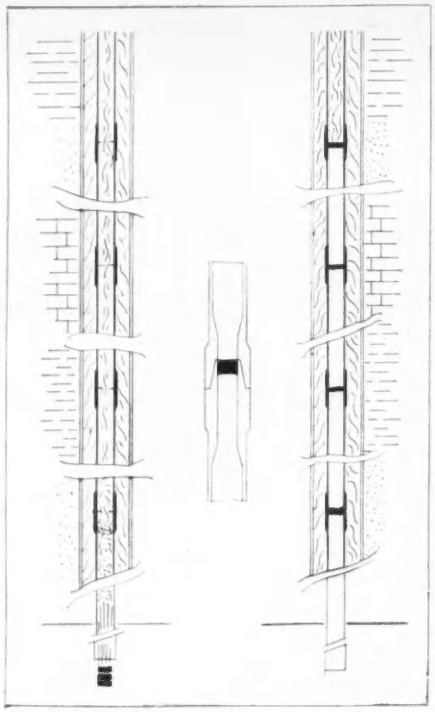


FIGURE 2. Showing the manner in which air, compressed below ice plugs, acts to force the obstructions upward with considerable force as the mud level outside the string tends to equalize within the plugged joints.

had been well below freezing for several days. The men were working normal positions required during the practices of stabbing and spinning-up pipe. There was no particular known reason then for them to be unduly cautious about keeping their heads or hands from over the open end of the drill string. In fact, other practices, such as the handling of elevators and rotary tongs often cause men to get their heads over the open end of pipe strings. There is no doubt that a crewman would perform those tasks without letting his head get directly over the open pipe if he knew that ice plugs were going to shoot out of that pipe with fatal force.

The rest of the circumstances involve the fact that the crew examined the remainder of the pipe stands resting on the racking platform. They found that from 1- to 1½-inch thick ice plugs were frozen in place in the interior of the pin section of the bottom tool joint of some stands.

The surface of the racking platform was made of wooden timbers which had been in use over a long period and had become "chewed up" and pulpy. The pin end of the stand sank into this pulpy surface and a seal was formed which would not permit the adhering film of drill mud from the interior surface of the stand to drain completely out of the stand.

On running the pipe back into the hole, the men, not knowing the ice plugs were in the interior section of the pin, made the stands up on the drill string in the usual manner. It must be noted here that those ice plugs could not have been seen by merely looking at the outside of bottom tool joint of stand. In other words, they were a normally unobservable hazard. The acts that are necessary to know, for sure, whether or not ice plugs have formed in the bottom pin, necessitate the driller hoisting the stand and allowing the pipe stabber time to look or feel before the stand is stabbed. This, of course, is required only during periods of below freezing temperatures.

If such plugs are found and are of such thickness as to cause the driller to believe that they would adhere to the pipe against the force of heat and pressure until they were lowered well down into the hole, then the adhesion of the plugs to the interior of pin should be broken. Even though this will take additional time, it must be remembered that a man's life might be spared in so doing.

A device for breaking the adhesion between an ice plug and the inner surface of a pipe stand can be shop-made. A piece of strap iron, ½-inch or more in thickness, 2 or more inches in width, and about 14 inches long could be used for the base and handle. A hole should be drilled through this for a piece of ¾- or 1-inch round bar stock. This round bar will form the plunger and should be 10 to 12 inches long. This plunger should be welded into a steel block ½-inch thick and shaped to fit into the tool joint box opening. The plunger and block then should be welded into the handle.

Air Compressed by Unbalanced Mud Column Levels

In theory, the force that caused the ice plugs to be blown from pipe with fatal effect is that the air in the drill string below the ice plugs is compressed by the force of the unbalanced mud column seeking a common level.

In other words, when pipe stands in which ice plugs are frozen to the interior section of bottom pin are screwed together and run into a well through a column of drill mud, there becomes a difference in the levels of the drill mud on the outside and inside of the drill pipe. A solid, thick ice plug which is frozen hard to the inner pin surface may go a considerable distance down through the mud column before being affected by heat and pressure to the point of turning loose.

It has to be reasoned, too, that all the plugs will not turn loose at once. The lower plugs probably turn loose singly, and as they do, the air above the mud column is compressed by the efforts of the mud levels to equalize. As the air pressure is increased, the top few plugs are probably literally torn loose from their adhesion to the pipe by the air pressure. The force with which these plugs could be blown from the open end of drill string is dependent upon many factors. It is well enough to know that it could be forceful enough to cause a fatal injury.

Accident Statistics by Practice

The basis of this paper has been founded on the results of a study of 700 oil well drilling rig accidents. Accident statistics developed, according to the operational practice involved, prove helpful in determining the practice to which the greater emphasis on prevention should be applied. A study of the accident experiences, grouped according to their specific practice occurrence, will provide

emphasis as to how to apply preventive measures.

In developing this paper, 3 operational practices were considered. All of the accident experiences that occurred within the total group of 700 that were associated with the Pipe Stabbing, Spinning and Racking Practices, were separately reviewed.

The practice of stabbing pipe was associated with 35 accident occurrences. The practice of manipulating spinning and make-up lines was found to be connected with 21 accidents out of the total of 700 drilling rig accidents. Eleven accident experiences occurred during the practice of racking pipe.

Pipe Stabbing

There are several phases to the Pipe Stabbing Practice. A pipe stabber, for instance, is subjected to a particular kind of exposure to accident when he is standing adjacent to the racked pipe; that is, when he is waiting for the elevators to be latched around the upper end of the stand, and the stand to be picked up to the proper level for stabbing.

This phase of the practice will be referred to as "Unracking Pin-Ends of Stands." During this unracking phase there were 5 injuries resulting from the pipe stabber getting his fingers mashed between 2 stands of pipe.

An accident of this nature is primarily due to inexperience on the part of the pipe stabber. Another element of cause, however, should be considered as a default of judgment on the part of the driller for not having properly trained his men to do that particular act safely.

Every pipe stabber should be continually cautioned until he adopts a safe work habit. He should be told that it is dangerous to place fingers between pipe stands. It should be explained to him that the "bellying-out" of the stand to be picked up varies according to the position the pin is occupying on the rack. This variable condition, of course, will have something to do with the space between the stand to be picked up and the remaining stands.

The "whip" and the extent of the resulting impact between the stand being picked up and the other stands is dependent on how fast the elevators are traveling at the time they run into the shoulder of the top box.

In this connection, the drillers should know that 5 additional accidents were caused, in part, by the driller running the elevators into the top box of stand too fast. The pipe stabber lost his grasp on the violently whipped lower end of stand and the stand swung toward and collided with the man standing on rotary. One of those accidents was a serious head injury.

Drillers are not being fair with themselves or their crews or the company for whom they work when they assume an attitude that a pipe stabber is entirely at fault for losing his hold on a violently whipped stand. There are cases where drillers have tried to justify high-speed recklessness because pressure was being applied from the toolpushers. No toolpusher will admit having expected a driller to operate a rig at a speed which is reckless to the point of contributing to a serious injury. Some toolpushers can't definitely say, however, that they didn't leave that impression. Where those rare conflicts of interpretation do exist, every effort should be made to come to an immediate and better understanding.

FIGURE 3. Illustrating the safe positioning of the hands when controlling the swing of the pin end of a stand as it is lifted by the elevator and allowed to move toward the rotary table. Hands placed as shown in the inset are guarded against contact between moving stand and racked pipe.

Creditable performance has been observed time and time again on the part of safe and efficient drillers. They show their inexperienced pipe stabbers how to place their hands on the pipe stand to be picked up. They tell those men how to let the stands drag up against the rest of the racked pipe until all of the whip in the stand has dissipated.

Those drillers have so perfected their technique of timing the speed "slow-down" of elevators just prior to their latching and hitting the box for the pick up, that the entire operation is noticeably smooth. Those drillers have records on which exceptionally few accidents have been recorded. If some drillers and their pipe stabbers can coordinate their actions smoothly and to the point of never getting anyone injured, certainly others can, if they try.

Another phase of the pipe stabbing practice involves the act of leaving the rack with the stand and taking it toward the rotary. This phase of the practice is termed: "Tailing the Stand to Rotary."

There were 11 accidents out of the stabbing practice total of 35 associated with this phase. There was only one instance in which the derrickman failed to latch the elevators and the pin end of pipe stand dropped on a man's foot. It should be needless to call attention to the fact that the recipient of that injury will be a cripple for the rest of his life.

The severity of the remaining "Tailing Stand" accidents was not too great. For the most part, the men slipped and fell, or were "whipped" into some obstruction like the tongs or pipe slips. Here again the preventive correction must come in the form of smooth, coordinated manipulation of drawworks with the pipe stabber's ability to perform.

The "Kelly Handling Phase" of the stabbing practice accounted for 4 accidents. There were 2 fingers amputated in stabbing the kelly into rat hole. These accidents could have been prevented by having had the pull-back rope snatch block better aligned so that the kelly would have been pulled directly over the rat hole. The use of hands near the point where the kelly is stabbed into the rat hole would then not have been necessary.

The two other accidents involved the kelly as it came loose from the pull-back rope while suspended and considerably to one side of center of derrick floor. The pin-end of the kelly swung free toward the rotary. Two men were caught between the colliding kelly and the drill string extension in rotary. In both cases bones were fractured.

In instances when the security of the tie of pull-back rope onto the kelly, or the hook used to pull it back to the rat hole is in question, men should not be standing on the rotary. In fact, they should not be standing anywhere in line with the probable "swing through" of the bottom of the kelly without being fully alert to the act in progress. The ties and hooks used should definitely be made safe.

The "mousehole stabbing" phase of the practice was not associated with any serious physical injuries. There were, however, 9 recoverable eye injury cases. An investigation disclosed that the majority of these eye injuries were the result of getting small, sharp flakes of rust lodged on the eyeball.

Mousehole stabbing principally comprises the handling of drill pipe singles that are brought onto the derrick floor from the pipe rack. In many instances these pipe singles have lain out in the weather for weeks. The surfaces of the pipe singles naturally become rusty. When men tail these singles in to stab them into the mousehole for a connec-

tion, they usually let the single slide through their gloved hands as they are lowered.

It is not necessary to keep hands on the pipe when it is being lowered, and often when it is done, it merely stirs loose a rust flake that may be blown into someone's eye by a strong wind.

Pipe Spinning

The operational practice of pipe spinning was associated with 26 accidents. All were the result of mishaps that occurred in connection with the use of the so-called forked make-up line. In other words, no straight rope spinning lines were involved with any of these accidents.

These accident experiences were associated with 3 exposure categories. The "Rotary End of the Spinning Act" was considered as a kind of exposure which differs in many respects to that of the "Cathead End of the Spinning Act." The "Driller's Exposure to Injury while Spinning" is still somewhat different from the others.

The "rotary-end exposures" accounted for 21 of the over-all total of 25 spinning accidents. The cathead-end exposures for only 2 accidents, and, in addition, 3 drillers were injured.

There were 7 eye injuries due to either mud particles from chain or pipe being thrown into eyes or the loose end of spinning chain hitting men in their eyes. Five were caused by mud particles and 2 by the chain.

There were 3 finger fractures due to men getting fingers beneath the wraps of chain. Three cases involved slivers of steel penetrating the men's hands.

The loose, whirling end of chain struck and severely lacerated 4 men's faces. One man's arm was fractured when the loose, whirling chain-end wrapped around it and pulled it against the pipe.

There was a mishap in which the chain broke and the flying end hit a man in the groin.

While men were preparing the spinning chain for use, ice plugs blew out of the open end of drill string extension in rotary. One man sustained caustic burns on the face from the drill mud; the other sustained an injury to his thumb when an ice plug struck it.

There is, perhaps, no other act on a drilling rig that requires a more keenly developed sense of "feel" than has to be possessed by the catheader when he is spinning-in a stand with the rope-end of the forked-line. The "bellying" back and forth of the pipe stand being made up causes the threads of the pin and box to have varying degrees of friction between them. Too hard a jerk by the catheader, when the threads are "frozen" against rotation, can and has jerked the chain from the chain handler's hands.

This lack of a cultivated "feel" on the part of the catheader has been the prime contributing cause for the chain flying through the air when jerked out of the chan handler's hands. Serious eye injuries, deep and severe facial lacerations, and fractured bones have too often been the result.

The "Cathead-end" of the Spinning Act" accounted for 2 mashed fingers when the catheaders allowed their fingers to get under a wrap of the line.

The "Drillers' Exposure to Injury While Spinning," according to the records used, is not particularly hazardous. The whipping swivel in forked-line hit a driller on the hip with a resulting minor effect. The rope broke in another instance and the flying end hit a driller in the eye. The chain was pulled loose from around tool joint under tension in another mishap. The driller in attempting to dodge the flying end of chain stooped over between the drum brake lever and the drawworks housing. The flying chain hit and whirled a couple of wraps of itself around the end of the brake lever. The rope end of the line was still spooling-up on the cathead. Tension tightened on the brake lever and pulled the driller hard against the housing. The friction wrap of the chain on handle pulled loose, however, before any serious injury or damage resulted.

Pipe Racking

The operational practice of Pipe Racking appears to be one of the least hazardous of all. There were 11 accidents involved with the practice out of a total of 700 studied.

These 11 accident experiences were classified according to 2 dissimilar exposures. The act of "Tailing Stand Off Rotary" was involved in four accidents. In each of the 4 mishaps, drill mud squirted into the men's eyes.

The act of "Racking the Stand" was involved in 7 accident experiences. Five injuries were the result of crewmen getting their hands caught between pipe stands being racked and the stands already resting on rack. A sliver of steel embedded deeply in a man's thigh in another mishap. This sliver was from an incomplete shear of tong die which left the sliver attached to the tool joint and protruding slightly outward. One man dropped a pipe stand aligning bar on his foot.

Through a more consistent method of training and cautioning men about definitely known accident producing circumstances, even normally safe operational practices can be made safer.

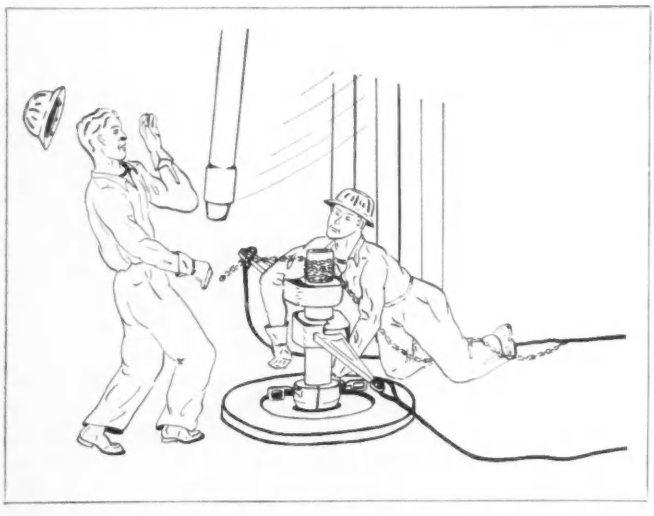


FIGURE 4. Effect of snapping the elevators into the tool joint at too high rate of speed, causing pipe to be jerked from crewman's grasp and endangering his life as well as the man at the farther side of the rotary.

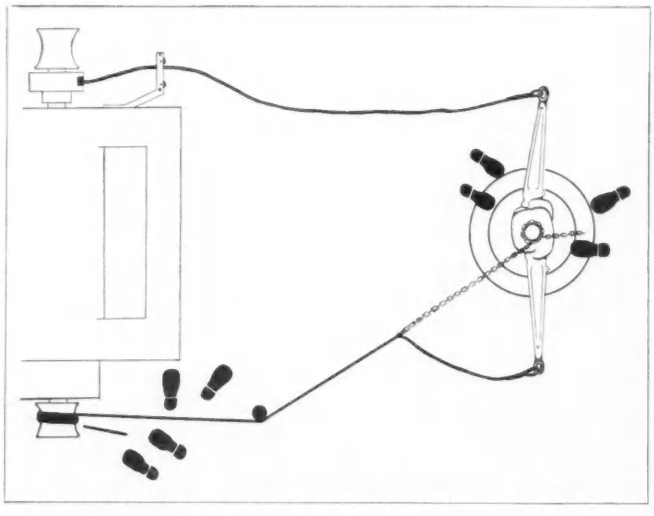
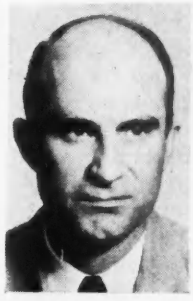


FIGURE 5. Setup of crew on floor as pipe is being spun in with forked-line hookup. Danger areas lie within swing of chain as it is unwrapped from stand, and in line of pull between stand and cathead after chain is freed.

The *Balanced* Rotary Rig

By C. H. OBERG
Standard Oil Company of California, Taft, California



A DRILLING RIG is called on to perform two main duties; first, to drill, which involves rotating the string and circulating fluid; second, to hoist or lower pipe. The first problem in obtaining a balanced rig is to establish power requirements for these two functions. The second problem is to use the information in establishing the distribution of horsepower to suit a particular set of conditions. This paper, substantially as printed, was presented at the Ninth Annual Convention of the AAODC.

THE range of load variations necessary to accomplish all the functions of a rotary drilling rig such as drilling, hoisting, fishing, pumping, rotating, and a host of auxiliary operations presents a huge and complex problem to the designer and purchaser. The operator's ultimate aim in assembling any drilling rig is to be able to drill wells with maximum speed and lowest cost. The contractor who underpowers and overloads his equipment or who provides capacity far in excess of that which is required is usually endangering his reputation and his financial position. The proper design and economy in a rotary drilling rig is a matter of engineering fact, and therefore sound engineering advice, seasoned with the salt of experience, should be obtained when planning to invest the huge sums involved in a modern drilling unit. Once the capacity of the rig has been established by the original design conditions, any substantially different set of conditions should be reviewed with care to establish what effect they will have on the equipment. This will allow modifications in the design or revisions in estimates to be made with due judgment.

A drilling rig is called upon to perform two distinct main functions which consume 40 to 60 percent of the total time expended on an average well. The first function is to drill, which involves rotating the drill pipe and circulating the drilling fluid. The second function is to hoist and lower pipe into and out of the well. These two functions are quite separate and the capacity of the rig for either is often underbalanced. It is generally recognized that the proper rig for use in drilling soft formations is uneconomical for use in drilling hard rock formations and vice versa. In the softer formations fewer trips are made and high pumping capacity is required. In the harder formations, more round trips are made and lower circulation rates are required.

The first problem in obtaining a balanced rig then becomes a matter of establishing the power requirements involved in performing the above two functions. The second problem involves the use of this information in establishing the distribution of horsepower to suit a particular set of conditions. Because of the current general interest in mechanical rigs powered with internal combustion engines, the following discussion will be centered on this type of equipment.

Value of High Circulation Rates

The circulation of mud is the major job on a rotary rig, consuming 70 to 85 percent of the horsepower hours used in drilling an average well.[1] Past investigations have shown that in all but the hardest formations, the rate of penetration is proportional to the rate of circulation. Nolley, Cannon and Ragland in a recent important paper[2] on drag bit research indicated that the rate of penetration of softer formations is directly proportional to the product of the rate of circulation and bit nozzle fluid velocity. Crake[1] emphasized the value of high circulating rates and stated that rate of flow determines the following:

1. The rate at which cuttings are lifted to the surface.
2. The volume of cuttings carried by each cubic foot of mud, and therefore, mud contamination.
3. The speed at which mud in the hole can be reconditioned, or the weight or other characteristics changed, to suit emergencies or other conditions.
4. The size of the cavings which can be removed and, thus, the hazard of sticking the pipe.
5. The amount of gas entrained in a cubic foot of return fluid and thus the blowout tendency of the fluid column.
6. The amount of bad mud contained

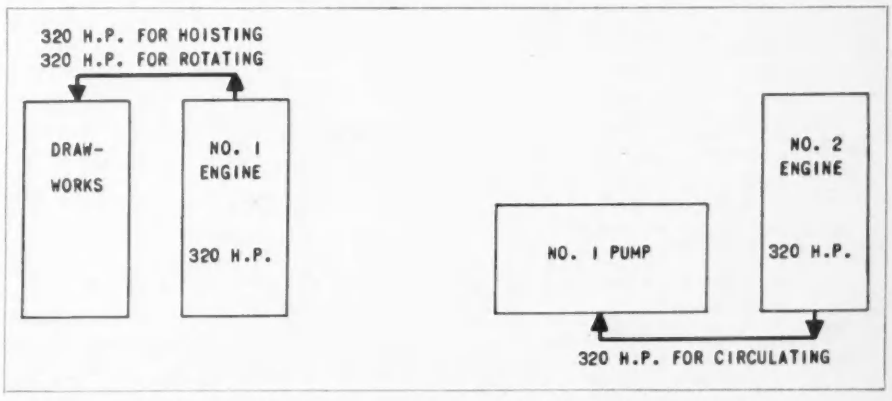


FIGURE 1. Illustration of balanced power layout for 3000-foot California-type drilling.
CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5 inches o.d., 19.5 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

in a well in case of a blowout hazard.

Thus the key to drilling efficiency lies first in the determination of the quantity of fluid in gallons per minute required to maintain proper velocity in the mud stream. This in turn will determine the friction losses and the power required for circulating mud.

Factors Involved

Although relatively high mean velocities in the returning mud stream and high nozzle fluid velocities are desirable, they are often limited in application by the friction head or pressure drop developed within the mud circulating system. In order to keep this pressure drop at a minimum careful attention must be given to the relationship of hole diameter to drill pipe size, using the largest size of drill pipe in the smallest hole diameter that will provide satisfactory clearance for fishing as well as clearance for running casing.

The annular velocities considered most satisfactory range from 2 to 4 feet per second, higher velocities being required where the formations are softer and the mud stream is required to carry more and larger cuttings. Greater annular velocities may cause the mud to have turbulent flow and require a much greater pressure head. High annular velocities also may impose greater pressure on the formation, causing loss of mud to the formation when circulating and expose the well to a blowout when circulation is stopped. This is explained by the fact that this pressure change might be equal to or greater than the difference between the formation and over-burden pressure.

The fluid velocity in the drill pipe is usually within the region of turbulent flow of the mud and for this reason the range of velocity in the pipe should be no greater than 8 to 11 feet per second to keep the pressure drop to a minimum. It is interesting that in the formula suggested by Beck, Nuss and Dunn[3] pressure drop in the drill pipe with turbulent flow is proportional to the square of the mud velocity, proportional to the mud density and inversely proportional to the diameter of the pipe.

A nozzle fluid velocity of 300 to 400 feet per second has proved desirable when drilling soft formations with jet type bits.[2] The practical limits on this important feature have not been well established but the resulting pressure drop is of such magnitude that it should not be overlooked when considering the design of a mud circulating system. The energy requirements for such nozzle velocities could amount to several hundred horsepower.

It should also be noted that the surface pipe, the standpipe, hose, swivel and kelly should be of a uniformly large inside diameter, should be short, and should be free of unnecessary turns in order to avoid large pressure drops when circulating large volumes of fluid. It is often surprising for many to learn that these surface items cause a pressure drop of as much as 150 pounds per square inch and require the use of energy equal to 75 horsepower. An additional power loss is suffered in the pump, normally considered to be 15 percent.

Pump Input Horsepower

The largest portion of the horsepower hours consumed in circulating mud is used in drilling the hole to be cased by the oil producing string. It is logical, then, that the pumping plant on a balanced rig should be determined in most cases by the circulation required when drilling the proper size hole for this casing. Table 1 was prepared to indicate the horsepower requirements for attaining various annular velocities in the popular sizes of hole drilled for 5½-inch and seven-inch casing. With the exception of high nozzle fluid velocities, the factors indicated in the previous paragraphs and current articles on the flow of mud were considered in the preparation of this table.[2,3,4,5,6]

In hard formation drilling with high ratios of drill pipe to hole diameters and low annular velocities, the required pump horsepower is only a fraction of the power needed for hoisting and can be supplied by the drawworks engines. For the drilling of softer formations with low drill pipe to hole diameter ratios and high annular velocities for the removal of many and large cuttings, the necessary pump horsepower is equal to or greater than the hoisting horsepower. For this reason, considerably more care must be taken to provide sufficient power balanced to suit the needs of the rig. Round trips are infrequent when drilling soft formations and it is imperative that large drill pipe such as five-inch or 5½-inch outside diameter be used in drilling the larger hole required in order to decrease the amount of installed horsepower and to lower maintenance and operating costs. The cost of circulating sufficient fluid when drilling harder formations is not so critical and the savings to be realized in using the larger drill pipe are offset by the added cost of wire lines and related hoisting equipment that are worn more rapidly when making frequent round trips with the heavier pipe.

Table 2 shows the typical horsepower requirements for the circulation of mud for California type drilling derived from the information shown on Table 1. Large-sized holes are required for the usual seven-inch casing and it is necessary to use large sizes of drill pipe to attain high annular velocities in the softer formations. Smaller pipe can be used economically in the harder and deeper formations where smaller holes are often drilled below protective strings of casing. The difficulties encountered in conditioning the hot, heavy and viscous muds used in deeper drilling usually require the addition of a pump for mud conditioning in addition to a standby pump. The drilling of large diameter holes for surface casing or intermediate strings may be accomplished with satisfactory annular velocities by paralleling the dual pump installations.

Power for Rotary Table and Hoisting Pipe

The power required for rotating varies over a wide latitude because of the many sizes of hole drilled and because of the range in speeds. A rule of thumb formula for the conventional type of drive is to use 1 horsepower for each revolution per minute of the table.[7] Ample horsepower for rotating is provided by the No. 1 engine on most mechanical rigs and it becomes a relatively minor problem.

An adequately powered drawworks will start hoisting drill pipe off bottom at rated depth at around 100 feet per

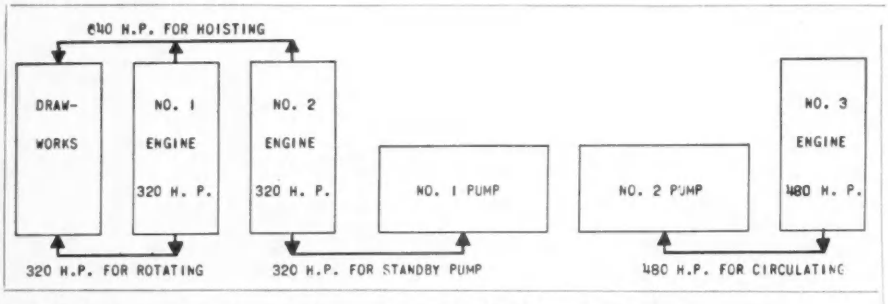

640 H.P. FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 320 H. P.
NO. 2 ENGINE 320 H. P.
NO. 1 PUMP
NO. 2 PUMP
NO. 3 ENGINE 480 H. P.
320 H.P. FOR ROTATING
320 H.P. FOR STANDBY PUMP
480 H.P. FOR CIRCULATING

FIGURE 2. Illustration of balanced power layout for 6000-foot California-type drilling.

CONDITIONS:

(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5 inches o.d., 19.5 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

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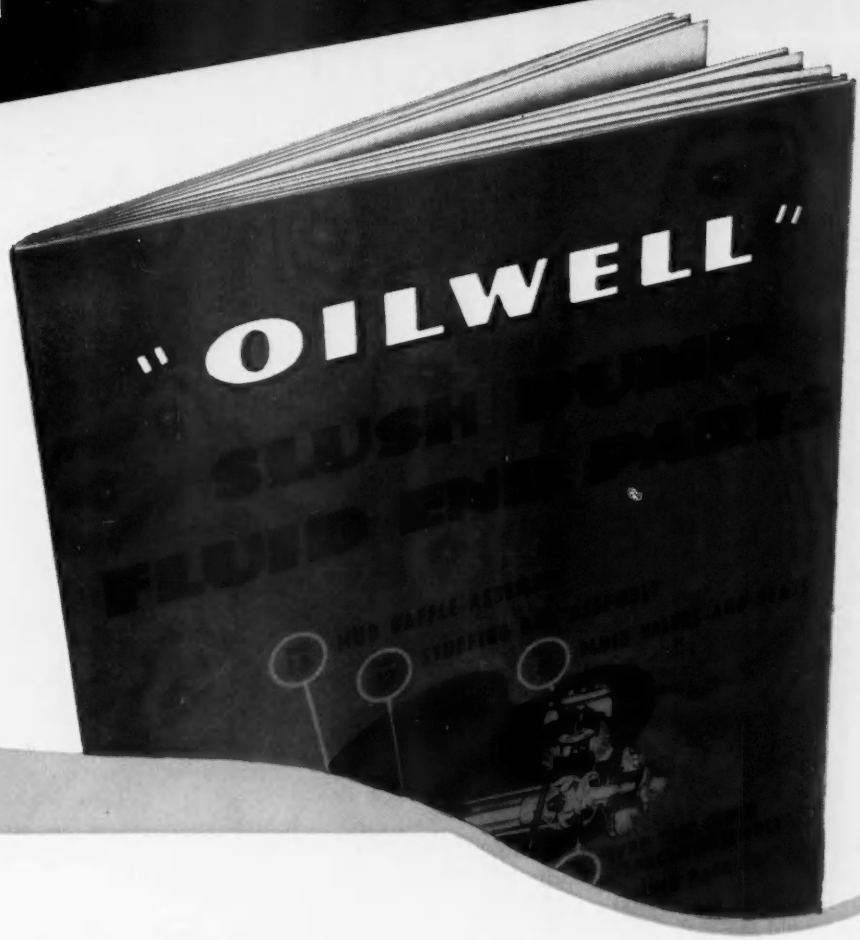

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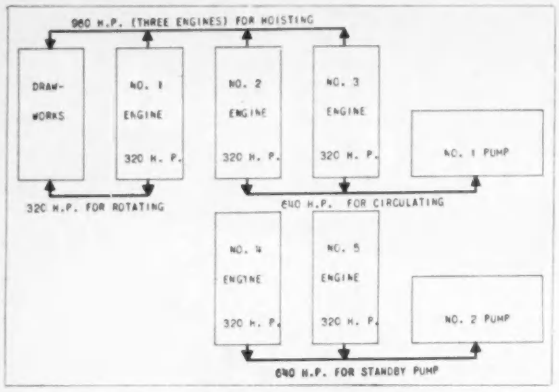

960 H.P. (THREE ENGINES) FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 320 H. P.
NO. 2 ENGINE 320 H. P.
NO. 3 ENGINE 320 H. P.
NO. 1 PUMP
320 H.P. FOR ROTATING
640 H.P. FOR CIRCULATING
NO. 4 ENGINE 320 H. P.
NO. 5 ENGINE 320 H. P.
NO. 2 PUMP
640 H.P. FOR STANDBY PUMP

FIGURE 3A. Illustration of balanced power layout for 9000-foot California-type drilling (Alternate 1, using 5½-inch drill pipe).

CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5½ inches o.d., 21.9 pounds, and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

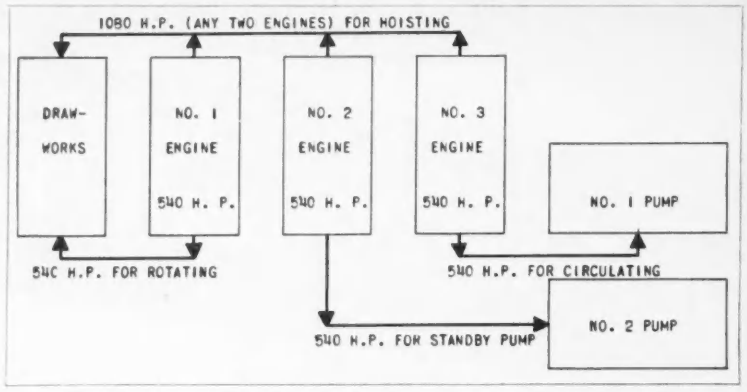

1080 H.P. (ANY TWO ENGINES) FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 540 H. P.
NO. 2 ENGINE 540 H. P.
NO. 3 ENGINE 540 H. P.
NO. 1 PUMP
540 H.P. FOR ROTATING
540 H.P. FOR CIRCULATING
540 H.P. FOR STANDBY PUMP
NO. 2 PUMP

FIGURE 3B. Illustration of balanced power layout for 9000-foot California-type drilling (Alternate 2, using 5-inch o.d. drill pipe).

CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5½ inches o.d., 21.9 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

minute. The rule of thumb method of calculating hoisting horsepower is to use 100 horsepower for each 1000 feet of 4½-inch drill pipe at rated depth. A change in drill pipe size or weight will change the depth rating or the horsepower required to a considerable extent. Table 3 indicates the input horsepower required with various combinations of pipe sizes and drill collar weights.

This table clearly shows that considerably more horsepower is required for hoisting larger sizes of drill pipe and for drilling harder formations with long lengths of drill collars. Since only a small fraction of the total drilling time on a well is used in making trips, any great increase in the available hoisting power above that indicated would not be warranted because only the hoisting time, or 7½ to 12½ percent of the total round trip time, would be affected.[1] However, in localities where few round trips are made, it might be desirable to decrease slightly the hoisting horsepower per 1000 feet and in areas with hard formations, where numerous round trips are made, it might be desirable to increase the unit power value.

A considerable power loss occurs between the engines and the hook. It is common to consider the loss in each line strung up as being equal to a 2 percent power loss. The loss in the compounding transmission, the selective speed transmission and the drawworks is usually in the range of 18 to 20 percent. The addition of torque converters between the engine and the hook will increase this power loss at full engine loads but will permit higher average hook horsepower.

It was noted that the drill collar weight influenced the hoisting horsepower. The required weight on the bit is governed by the type of drilling being performed and the crushing strength of the formation. Sufficient drill collars are usually provided so that the bit weight is ⅔ to ¾ of the drill collar weight.

Balancing the Power Requirements

In order to provide an example of balanced power for the major drilling functions of hoisting, rotating and circulating, the data contained in Tables 1, 2 and 3 were combined into Figures 1 through 5 to illustrate desirable power arrangements for California type drilling. The depth ratings of the rigs were shown in increments of 3000 feet as it was believed that the economic drilling depth of each unit would range sufficiently to cover intermediate operations satisfactorily.

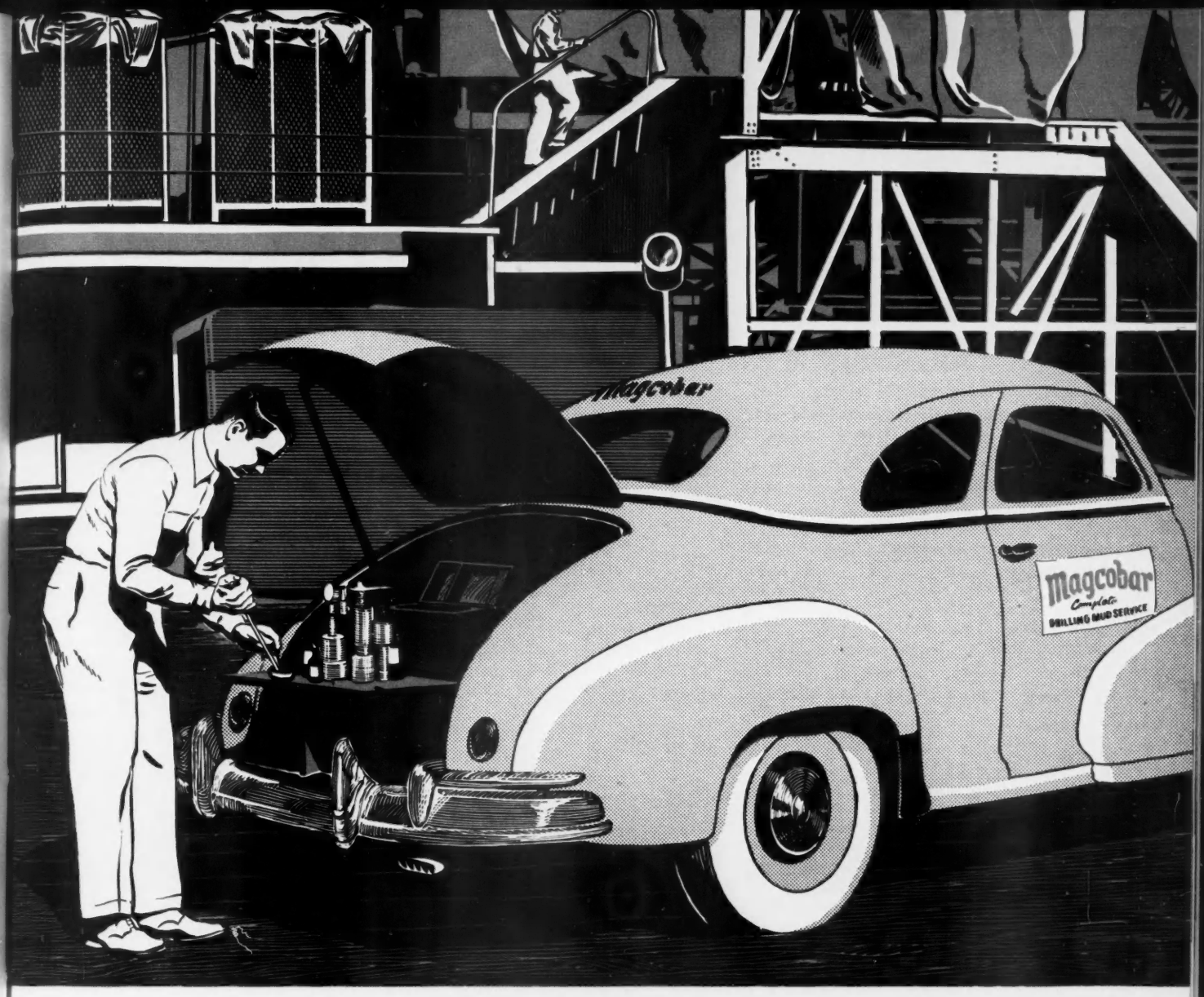
Fast drilling of the soft formations in California requires that an annular velocity of three feet per second be maintained. As it is common to drill an 11-inch hole for the usual seven-inch water or oil string, it is imperative to use five-inch or 5½-inch drill pipe in order to keep the mud pumping power plant to a reasonable size. By installing sufficient horsepower to obtain the three feet per second velocity with ten pounds per gallon or 75 pounds per cubic foot mud at rated depth, sufficient power is available to obtain desirable higher annular velocities at more shallow depths or in the slightly smaller holes that are sometimes drilled for the seven-inch casing. It also insures an ample velocity of mud in case the circulation pressure losses are increased with heavier mud weights. Because of the difficulties encountered with crooked holes caused by tilting formations, very light weight is carried on the bit and a drill collar load of 20,000 pounds is common.

One engine on the pump and one on the drawworks has been proved most satisfactory for 3000-foot drilling. The use of five-inch drill pipe allows the use of the same size of engine on the pump and on the hoist in order to obtain the desirable annular velocity of three feet per minute and hoisting speed of 100 feet per minute. The use of either 4½- or 5½-inch drill pipe places the power requirements out of balance, making the pump engine larger in one case and the hoist engine larger in the other.

To obtain the desirable annular velocities and hoisting speeds for 6000-foot drilling with five-inch drill pipe requires 480 horsepower for the pump and two 320 hp engines on the hoist. This appears to have better power balance than when using 5½-inch drill pipe requiring 390 hp on the pump and two 350 hp engines on the hoist. With this size of rig it is advantageous to have a standby and mud mixing pump, smaller than the main pump, operated by one of the hoist engines.

For 9000-foot drilling, it is desirable to have the standby pump of equal size with the main pump. In some cases it is necessary in drilling to this depth to install a third small pump for mud conditioning and mixing. The horsepower advantage when using 5½-inch drill pipe is more apparent with this size of rig. The balanced power layout with 5½-inch drill pipe provides an alternate hoisting engine and has fewer packages to handle when moving. It has the disadvantage of providing an excess of power to the rotary and when an engine is down, the mud circulating system is crippled to a greater extent.

For drilling to greater depths, the power layout is much the same as for the 9000-foot rigs, except for size. It is necessary to install a third pump for deeper drilling operations to provide adequate facilities for the mixing and conditioning of mud. Often all three pumps must be operated simultaneously: one for circulating mud, the second for conditioning the mud in the circulating system, and the third for mixing new



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With their laboratory-equipped field cars . . . complete with radio telephones for immediate contact . . . Magcobar engineers are available night and day to assist operators with their mud problems right at the rig. To meet the demands of the Magcobar engineer's laboratory diagnosis, there are more than 250 stockpiles of Magcobar mud weighting materials and chemicals strategically located at dealers' stores throughout the oil fields.

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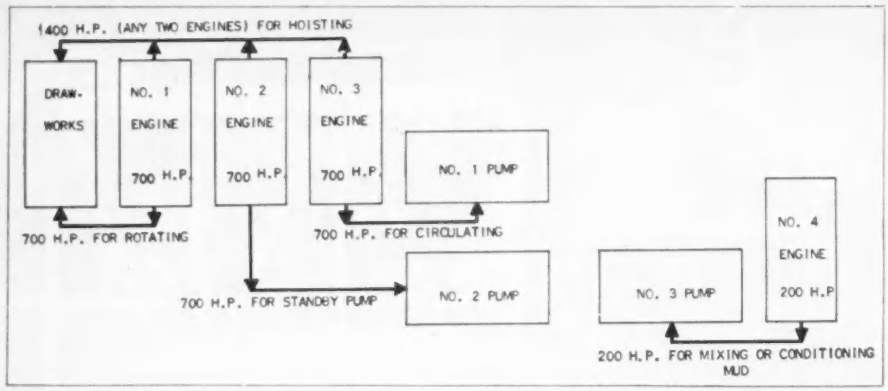
1400 H.P. (ANY TWO ENGINES) FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 700 H.P.
NO. 2 ENGINE 700 H.P.
NO. 3 ENGINE 700 H.P.
NO. 1 PUMP
NO. 4 ENGINE 200 H.P.
700 H.P. FOR ROTATING
700 H.P. FOR CIRCULATING
700 H.P. FOR STANDBY PUMP
NO. 2 PUMP
NO. 3 PUMP
200 H.P. FOR MIXING OR CONDITIONING MUD

FIGURE 4A. Illustration of balanced power layout for 12,000-foot California-type drilling (Alternate 1, using 5½-inch drill pipe).

CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5½ inches o.d., 21.9 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

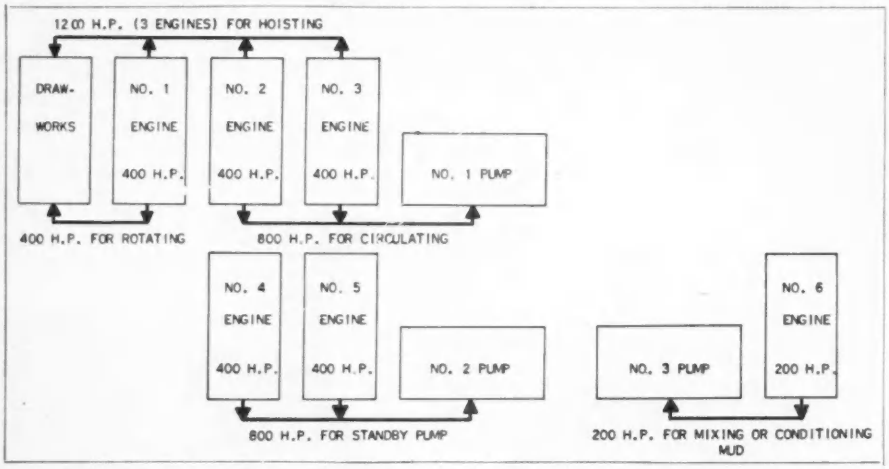
1200 H.P. (3 ENGINES) FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 400 H.P.
NO. 2 ENGINE 400 H.P.
NO. 3 ENGINE 400 H.P.
NO. 1 PUMP
NO. 4 ENGINE 400 H.P.
NO. 5 ENGINE 400 H.P.
NO. 6 ENGINE 200 H.P.
400 H.P. FOR ROTATING
800 H.P. FOR CIRCULATING
NO. 2 PUMP
NO. 3 PUMP
800 H.P. FOR STANDBY PUMP
200 H.P. FOR MIXING OR CONDITIONING MUD

FIGURE 4B. Illustration of balanced power layout for 12,000-foot California-type drilling (Alternate 2, using 5-inch o.d. drill pipe).

CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5 inches o.d., 19.5 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

TABLE 1
Approximate Horsepower Requirements for the Circulation of Mud

DEPTH	Hole Diam. (Inches)	2 FT. PER SECOND Annular Velocity			3 FT. PER SECOND Annular Velocity			4 FT. PER SECOND Annular Velocity		
		4½" IF	5" IU	5½" FH	4½" IF	5" IU	5½" FH	4½" IF	5" IU	5½" FH
3,000	11	160	105	80	460	300	260	1,110	760	570
	9⅞	90	55	50	240	160	130	520	350	260
	8¾	40	30	25	90	65	60	210	135	170
	7⅞	20	20	....	40	30	....	70	50	....
6,000	11	250	160	130	750	460	390	1,790	1,120	830
	9⅞	140	85	80	390	250	200	850	540	400
	8¾	70	50	45	150	110	100	350	210	230
	7⅞	35	35	....	75	55	....	120	85	....
9,000	11	350	220	180	1,050	610	510	2,460	1,480	1,100
	9⅞	200	115	105	530	330	260	1,180	730	530
	8¾	95	70	60	210	150	140	480	290	290
	7⅞	55	50	....	105	85	....	170	120	....
12,000	11	440	280	230	1,350	760	640	3,140	1,840	1,350
	9⅞	260	140	135	690	420	330	1,510	920	660
	8¾	120	90	80	270	190	180	620	370	350
	7⅞	70	70	....	135	110	....	220	155	....
15,000	11	540	340	280	1,640	920	770	3,820	2,220	1,610
	9⅞	310	170	160	850	510	400	1,840	1,110	790
	8¾	150	110	100	330	230	220	760	440	410
	7⅞	85	85	....	165	135	....	270	190	....
Gallons per Minute	11	500	470	440	740	710	670	980	940	880
	9⅞	380	360	330	580	540	500	770	720	670
	8¾	270	250	220	410	380	350	550	500	450
	7⅞	160	140	....	240	210	....	320	280	....

NOTE: (1) Approximate mud weight 10.0 lbs. per gallon or 75 lbs. per cu. ft. power required varies approximately in direct proportion to mud density.
(2) In above computations, the bit was considered to have four ¾ inch holes. High Fluid nozzle velocities were omitted.
(3) Nominal weights of pipe shown: 4½"—16.6 lbs.; 5"—19.5 lbs.; 5½"—21.9 lbs.

mud, transferring mud to other tanks, or circulating mud over a cooling tower or degassing tower.

In providing balanced power to a rig, care should be taken to install engines of equal size and type in order to provide a means of keeping operating costs and supplies to a minimum. A crew that is thoroughly familiar with one size and type of engine will help to decrease maintenance costs.

Design of Hoisting Equipment

After the major power requirements of a rig have been determined and balanced as indicated above, consideration should be given to the equipment to make certain that each part is balanced to the power available and to the work to be performed. A discussion of the design factors to be discussed follows.

The design of the hoisting system of a rotary rig is governed by the wire line to be used. The working strength of the line will determine the depth to which it can economically handle a given size of drill pipe. The diameter of the line and type of construction will determine the crown and traveling block sheave diameters, the drawworks drum size, and the brake diameter. As insurance for a reasonably long wire rope life, the working load on the line when handling drill pipe should be one-fourth of the breaking strength of the line. A 3 to 1 factor of safety may be used satisfactorily at the slow speeds used when running casing. The general practice in the industry is to reeve 6 to 8 lines for shallow to medium drilling depths and to use 8 to 10 lines for medium to deeper drilling. Two additional lines are often added for running casing. The most satisfactory type of rope used for rotary hoist service is the 6 x 19 Seale type of construction. Table 4 indicates the capacities of various sizes of lines under various systems of reeving. Table 5 indicates the safe drilling depths for various combinations of wire lines and drill pipe sizes, based on a safety factor of four to one for the wire line.

Derrick Load

The strength of the wire line can also be utilized to determine the capacity of the derrick in which it is to be used. In this case a factor of safety of two for the wire line should be specified. This is the same factor of safety used in the design of the derrick. Table 5 indicates the derrick load for various sizes and strengths of wire line under different systems of reeving.

The height of the derrick should depend on the depth of the well and the frequency of the round trips. The size of the wire line used will also influence the height of the derrick as the size and

Baash-Ross News

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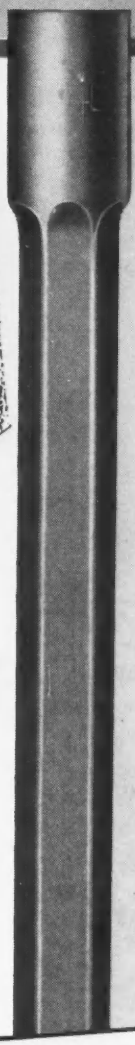
OUR 30th YEAR

Hex Kellys Give the Most in PERFORMANCE FEATURES



...and BAASH-ROSS GIVES THE MOST IN HEX KELLYS!

The Hexagon Kelly has become firmly established among performance-minded oil men as the *best* all-around kelly for modern drilling operations. It is not only easier to keep straight, is stronger, has greater circulation area, and incorporates many other important features (as highlighted at right) . . . but, in addition, it can be used for *both* regular and pressure drilling operations without change. This added feature greatly simplifies equipment inventories and also saves vital time when pressure emergencies occur — both advantages of utmost importance!

And Baash-Ross is the organization that, from the very beginning, has consistently led in the development of the Hexagon Kelly . . . in the development of better metallurgical and heat treating processes for incorporating the best *balance* of physical properties into Baash-Ross Hexagon Kellys . . . in the development of better machining techniques to assure a straighter bore, better joint alignment, more uniform wall thickness and other advantages in *Baash-Ross* Hexagon Kellys.

Result — when you combine the natural advantages of Hexagon Kellys with the *added* advantages of Baash-Ross manufacturing and control techniques you get a new standard of kelly performance when you specify *Baash-Ross Hexagon Kellys!*

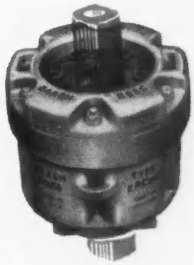
These are the NATURAL ADVANTAGES of Hexagon Kellys . . .

- **SMOOTHER RUNNING** — because they are *machined* — not forged — to shape, hence have closer tolerances, better balance!
- **GREATER RESISTANCE TO BENDING** — because even across their weaker axis they are 17½% more resistant to bending than the comparable size square kelly across its *stronger* axis!
- **36% MORE CIRCULATION AREA** — because of greater cross-sectional area. Particularly vital with today's full-hole pipe and high-volume pumps!
- **24% STRONGER IN TORQUE** — because of their shape and greater cross-section. Doubly important with today's longer strings, higher rotational speeds!
- **GREATER TENSIONAL STRENGTH** — because of more cross-section. A valuable feature with today's heavier strings!
- **MAXIMUM ADAPTABILITY** — because they can be used for *both* regular and pressure drilling *without* change. Simplifies inventories, saves vital time in pressure emergencies!

These are the ADDED ADVANTAGES You Get in BAASH-ROSS Hexagon Kellys!

- **BEST BALANCE** of shock-resisting *toughness* and wear-resisting *hardness* resulting from the exclusive Baash-Ross method of subjecting specially-selected alloy steels to multiple *full-length* heat-treatments that develop the metallurgical properties of the steel for both hardness and toughness.
- **UNUSUALLY ACCURATE BORE,** exactly centered end-to-end and then individually checked by special survey equipment.
- **PRECISE JOINT ALIGNMENT,** double-checked by the Baash-Ross Alignoscope, assures concentric rotation and freedom from joint failures.
- **PLUS EQUALLY RIGID CHECKS** on overall straightness . . . on thread form, taper, lead and finish . . . on dimensional accuracy of drive faces, upsets, etc. . . . checks that meet all API specifications as well as extremely close Baash-Ross specifications.

The ideal teammate for Baash-Ross Hex Kellys . . .



the BAASH-ROSS HEX ROLLER KELLY BUSHING

All the advantages of roller bushing performance—plus vital quick-adjustment feature!

When you adopt Hex Kelly equipment, be sure to get the utmost in Hex Kelly performance by driving your kellys with a Baash-Ross Hex Roller Kelly Bushing—*the Bushing especially designed for use with hexagon kellys!*

Not only does this Bushing provide all the well-known advantages of Baash-Ross Roller Kelly Bushings . . . instant friction-free response to bit feed, better control of weight, more footage per bit, longer equipment life and higher all-around drilling efficiencies . . . *but it also permits quick adjustment to provide the close fit so essential for maximum Hex Kelly performance.*

The narrower driving faces on Hex Kellys make it vitally important that a close fit be maintained between the Bushing and Kelly at all times.

In the Baash-Ross Kelly Bushing this adjustment is readily made by simply adding or removing Adjusting Shims in the body. Each set of Shims added or removed changes the working diameter by exactly 1/32", making close adjustment a quick, simple operation. (See page 416 of your 1950 Composite Catalog for further details on this vital adjustment feature!)

FOR: • Greater Footage per Bit • Greater Freedom from Twist-Offs • Smoother, Faster Drilling • Longer Kelly and Equipment Life standardize on Baash-Ross Hexagon Kellys driven by Baash-Ross Hex Roller Kelly Bushings . . . *the perfect combination for maximum drilling efficiency!*

BAASH-ROSS KELLYS ARE AVAILABLE THROUGH LEADING SUPPLY STORES

width of the drawworks drum will be determined by the wire line size. The width of the drum and the height of the derrick will then be influenced by the fleet angle the line coming off the drum makes with the center line of the fast sheave in the crown block. It is recommended that this angle be less than 1½ degrees.

The time spent in making round trips is usually such a small portion of the total time spent on a well that the savings obtained by faster round trip time in the taller derrick or mast should be carefully analyzed in order to justify the greater investment and added moving cost. The usual balance attained in this matter involves the use of 90-foot masts for shallow drilling, 126- to 136-foot masts or derricks for medium deep drilling, and 150- or 189-foot derricks for deeper drilling.

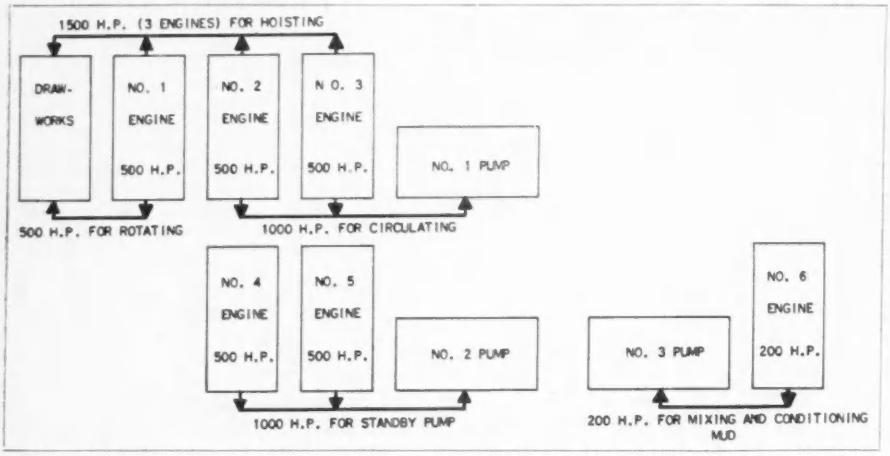

1500 H.P. (3 ENGINES) FOR HOISTING
DRAW-WORKS
NO. 1 ENGINE 500 H.P.
NO. 2 ENGINE 500 H.P.
NO. 3 ENGINE 500 H.P.
NO. 1 PUMP
500 H.P. FOR ROTATING
1000 H.P. FOR CIRCULATING
NO. 4 ENGINE 500 H.P.
NO. 5 ENGINE 500 H.P.
NO. 2 PUMP
NO. 3 PUMP
NO. 6 ENGINE 200 H.P.
1000 H.P. FOR STANDBY PUMP
200 H.P. FOR MIXING AND CONDITIONING MUD

FIGURE 5. Illustration of balanced power layout for 15,000-foot California-type drilling.

CONDITIONS:
(1) Drilling 11-inch hole for 7-inch casing.
(2) Drill pipe 5 inches o.d., 19.5 pounds and drill collars 20,000 pounds.
(3) Annular velocity 3 feet/second at rated depth.
(4) Mud weight 10 pounds/gallon, 75 pounds/cubic foot.
(5) Hoisting rate 100 feet/minute at rated depth.

TABLE 2
Typical Horsepower Requirements for the Circulation of Mud
California Type Drilling

DEPTH (Feet)	Drill Pipe (O.D.)	Hole Size (Inches)	Casing Size (Inches)	Annular Velocity (Ft./Sec.)	Pump	Pump Engine Horsepower*	Service
3,000	5	11	7	3	No. 1	320	Circulating
6,000	5	11	7	3	No. 1 No. 2	320 480	Circulating Stand by
6,000	5½	11	7	3	No. 1 No. 2	410 410	Circulating Stand by
9,000	5	11	7	3	No. 1 No. 2	640 640	Circulating Stand by
9,000	5½	11	7	3	No. 1 No. 2	540 540	Circulating Stand by
12,000	5	11	7	3	No. 1 No. 2 No. 3	800 800 200	Circulating Stand by Mud Conditioning
12,000	5½	11	7	3	No. 1 No. 2 No. 3	680 680 200	Circulating Stand by Mud Conditioning
15,000	5	11	7	3	No. 1 No. 2 No. 3	970 970 200	Circulating Stand by Mud Conditioning

NOTE: * Efficiency of engine to pump drive assumed to be 95 percent.

TABLE 3
Approximate Input Horsepower for Hoisting at Rate of 100 Feet Per Minute

DEPTH (Feet)	Engine to Hook Efficiency (Percent)	DRILL COLLAR WEIGHT 20,000 LBS.			DRILL COLLAR WEIGHT 40,000 LBS.			DRILL COLLAR WEIGHT 60,000 LBS.		
		4½" IF	5" IU	5½" FH	4½" IF	5" IU	5½" FH	4½" IF	5" IU	5½" FH
3,000	70	310	340	370	380	410	440	440	470	520
6,000	70	550	620	700	620	680	770	680	750	840
9,000	65	860	970	1,100	930	1,040	1,180	1,000	1,110	1,260
12,000	65	1,120	1,270	1,450	1,190	1,340	1,530	1,260	1,410	1,610
15,000	65	1,380	1,570	1,800	1,450	1,640	1,880	1,520	1,710	1,950

NOTE: (1) Effect of buoyancy neglected as it is assumed to be equal to wall friction.
(2) Nominal weights of pipe shown: 4½"—16.6 lbs.; 5"—19.5 lbs.; 5½"—21.9 lbs.

Derrick Tackle

The design of the crown block and traveling block should be influenced by the size of the wire line to be used. The Wire Rope Institute recommends that the minimum diameter of the sheave be 30 times the wire rope diameter for the usual 6 x 19 Seale type of construction. A factor of 45 times the rope diameter should be used when possible to improve the life of the rope.

The capacity of the hook, crown block and traveling block may also be designed on the basis of the strength of the wire line used. As in the case of the derrick capacity, a factor of safety of two for the wire rope should be used. Current design practice for the hook and blocks requires the use of a factor of safety of four. Table 6 shows suitable capacities for this equipment balanced to the wire rope capacity.

The life of the bearings in the crown and traveling blocks will be materially lessened if the rated speed and load on the bearings are surpassed. Care must be exercised to choose blocks with ample bearings for the tonnage and speed anticipated in order to obtain reasonable bearing life.

The importance of having balanced sizes and capacities of equipment in contact with the wire rope on deeper wells is indicated by the anticipated ton miles of service as follows:

Depth of Well	Formation	Anticipated Ton Miles
3,000	Soft	500
6,000	Soft to Medium	4,000
9,000	Hard	20,000
12,000	Medium	30,000
15,000	Hard	100,000

Drawworks Design

The design of the drawworks should be determined by the wire line size required to handle the drill pipe and drill collars at rated depth. The size of the line will directly limit the specifications of the drum and will indirectly govern the horsepower input to the drawworks based on the formula of hoisting the rated load of drill pipe at 100 feet per minute. On most drawworks this speed is accomplished with the middle transmission speed. The high speed is governed by the speed with which the crew can handle the equipment with the usual number of lines up. The line speed in high normally ranges from 2000 feet per minute on light rigs up to 3500 feet per minute with larger hoists. The low speed is usually governed by the gearing required to permit one engine to hoist the total load or by the slow speed requirements for fishing operations. The speeds between high and low are usually controlled by the shaft centers and the standard sprockets sizes for the chain

For Economical, Dependable Rotation of Your Drilling String

USE AMERICAN IRON

Hex or Square

KELLYS!

HEX KELLYS

American Iron Hex Kellys are made from *fully heat treated* alloy steel forgings for longer wear and greater resistance to torsional stresses. Driving surfaces are machine finished—and circulation holes precision bored—for smoother running and proper balance at all drilling speeds. Our manufacturing processes and scientific inspection insure straightness, joint alignment, concentricity of bore, hardness and precision threaded connections.

SQUARE KELLYS

American Iron Square Kellys are also made from a heat treated one piece alloy steel forging with top and bottom integral upset ends formed during the forging operation. The radius on the square of the driving surface is correctly formed during the forging operation. Correct forging processes plus straightness, joint alignment, concentricity of bore, hardness and precision threaded connections, make the American Iron Square Kelly the best balanced square kelly available.

BALANCED FOR SMOOTH RUNNING at all drilling speeds

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required for the particular loading used. The drum diameter should be approximately 25 times the rope diameter in order to obtain good wire rope life.

The need for more than three or four speeds in the drawworks of a standard mechanical rig is shown in Figure 6.[7,8] The power curve is for a six speed drawworks driven by engines capable of delivering 340 hp when loaded to capacity. As each stand of pipe is pulled, the load is lightened, but with the governor holding the engine to constant speed, the hoisting speed remains the same until the load is lightened sufficiently to permit shifting into the next gear. With the speed constant and the load decreasing, the power delivery of the engine decreases within each gear. It is apparent that the smaller the number of available speeds, the larger will be the drop of power used in each drum speed in relation to the engine capacity. On rigs equipped with torque converters, the speed of hoisting in any given gear increases as the load becomes lighter and the power of the engine is fully utilized. The number of gear changes can be reduced on such rigs as the torque converter automatically takes care of a wide selection of speeds.

Auxiliary Brakes - Engine Selection

Each drawworks should be equipped with an auxiliary brake calculated to absorb and dissipate the energy involved in lowering the heavy drill pipe and casing loads. The size of the brake should be developed on the basis of the wire line used and the speed of lowering the block. The speed factor commonly used is equal to lowering a 90 foot stand in 15 seconds. For wire lines of improved plow steel with hemp centers, the energy that would have to be absorbed for lines from 1 inch to 1½ inches in diameter would range from 1000 to 3500 hp, or more than twice the hoisting horsepower.

In order to insure satisfactory engine service and provide ample power for the operation of the equipment, it is necessary to inject certain safety factors into the engine specifications. In drilling operations, it is necessary to avoid expensive shutdowns and a conservative engine rating is imperative. All too often the operator chooses an engine on the basis of the ideal power curve and finds that his rig is underpowered and the engine overloaded. In other words, it is not balanced to the requirements of the other parts of the rig which were designed with ample safety factors. The usual engine power curve is obtained from data developed with the engine operating under ideal conditions, conditions that are seldom, if ever, attained in the field. Factors that should be considered in choosing an engine:

1. Anticipated altitude and temperature changes from the standard atmospheric pressure of 29.9 inches of mercury and 60° F.
2. Power requirements for auxiliary engine equipment such as fans, water pump, generator, etc.
3. Mechanical perfection of engine that might vary because of wear or maladjustment.
4. Allowance for a conservative maximum piston speed of approximately 1000 feet per minute and a maximum brake mean effective pressure of 80 for an unsupercharged engine.
5. Energy value of the fuel different from the standard test fuel.

TABLE 4
Strength of Wire Lines

SIZE LINE (Inches)	Breaking Strength (Lbs.)	Hook Working Load, Lbs. (S. F. 4)			Derrick Load, Lbs. (S. F. 2)			
		6 Lines	8 Lines	10 Lines	6 Lines	8 Lines	10 Lines	12 Lines
PLOW STEEL, 6 x 19 SEALE CONSTRUCTION, HEMP CENTER								
1	73,000	95,500	123,000	147,000	259,000	312,000	361,000	407,000
1⅛	91,000	119,000	152,000	184,000	323,000	389,000	450,000	508,000
1¼	112,000	141,000	188,000	226,000	398,000	478,000	555,000	625,000
1⅜	135,000	176,000	226,000	273,000	480,000	576,000	668,000	754,000
1½	160,000	210,000	268,000	324,000	569,000	683,000	793,000	893,000
IMPROVED PLOW STEEL, 6 x 19 SEALE CONSTRUCTION, HEMP CENTER								
1	84,000	110,000	140,000	169,000	297,000	358,000	414,000	471,000
1⅛	105,000	137,000	176,000	212,000	374,000	450,000	512,000	576,000
1¼	129,000	167,000	215,000	260,000	458,000	552,000	638,000	720,000
1⅜	155,000	202,000	260,000	314,000	551,000	663,000	766,000	864,000
1½	184,000	239,000	308,000	372,000	663,000	784,000	893,000	1,027,000

NOTE: Wire lines with independent wire rope center have strengths 7½ percent greater than values shown.

TABLE 5
Approximate Safe Working Lengths of Drill Pipe for Various Wire Lines

SIZE LINE	Lines Up	PLOW STEEL, HEMP CENTER 6 x 19 SEALE CONSTRUCTION S. F. 4				IMPROVED PLOW STEEL HEMP CENTER 6 x 19 SEALE CONSTRUCTION S. F. 4			
		3½" O.D. 13.3 Lbs.	4½" O.D. 16.6 Lbs.	5" O.D. 19.5 Lbs.	5½" O.D. 21.9 Lbs.	3½" O.D. 13.3 Lbs.	4½" O.D. 16.6 Lbs.	5" O.D. 19.5 Lbs.	5½" O.D. 21.9 Lbs.
1 Inch	6	7,100	5,400	4,800	4,100	8,300	6,300	5,500	4,800
	8	9,300	7,100	6,200	5,400	11,300	8,300	7,200	6,200
	10	11,300	8,700	7,600	6,500	13,200	10,100	8,800	7,600
1⅛ Inch	6	8,400	6,500	5,500	4,900	10,100	7,700	6,700	5,800
	8	11,100	8,600	7,500	6,400	13,300	10,100	8,800	7,600
	10	13,700	10,500	9,200	7,900	16,300	12,500	10,800	9,400
1¼ Inch	6	10,500	8,000	7,000	6,100	12,300	9,400	8,200	7,100
	8	13,800	10,600	9,200	8,000	16,100	12,400	10,700	9,300
	10	17,100	13,100	11,400	9,900	19,900	15,300	13,300	11,500
1⅜ Inch	6	12,500	9,600	8,400	7,300	14,600	11,400	9,800	8,400
	8	16,600	12,700	11,100	9,600	19,500	14,900	13,000	11,200
	10	20,500	15,800	13,800	11,900	.....	18,300	16,000	13,700
1½ Inch	6	14,900	11,400	10,000	8,600	17,400	13,400	11,600	10,000
	8	19,000	15,100	13,200	11,300	23,000	17,600	15,300	13,400
	10	.....	18,600	16,200	14,000	.....	21,700	18,900	16,300

NOTE: (1) Wire lines with independent wire rope center can be satisfactorily used to depths 7½ percent greater than shown above.
(2) Tool joints considered in above table but drill collars neglected.
(3) Buoyancy factor used for 10 lb. per gallon or 75 lb. per cu. ft. mud.
(4) Traveling block and hook assembly considered to weigh as follows for each size of line:
1"—10,000 lbs.; 1⅛"—15,000 lbs.; 1¼"—20,000 lbs.; 1⅜"—25,000 lbs.; 1½"—30,000 lbs.

Mud Circulating Equipment

In addition to drill pipe having a high ratio of pipe diameter to hole diameter, there are other factors to consider in the design of the mud circulating equipment. In the slush pump itself, it is desirable for best performance to keep the piston speed under 140 feet per minute mean velocity. The maximum speed in a power pump is determined by the pressure drop in the suction system and the fluid inertia. If these items exceed atmospheric pressure, the pump cylinders will not fill properly and severe fluid pound will occur. Supercharging of the suction with another pump improves this condition.

In estimating the proper size of pump, the mechanical and hydraulic efficiency of the pump must not be overlooked. This is usually considered to be 85 percent.

The swivel is another portion of the mud circulation system that requires careful analysis to fit it properly into the rig requirements. It should normally be able to handle a gross loading equal to the loading of the hook with which it is used. The limiting factor in the choice of a swivel is the load and speed characteristics of the bearings. In hard drilling with heavy weight on the bit

and slow rotary speeds, the bearings in a particular swivel would have a much longer life than if the same swivel were operated with light weight on the bit and high rotary speeds. API Standard No. 4 indicates the speed and life conversion factors for bearings. A bearing rated at 100 tons for 100 revolutions per minute would have a rating of only 69 tons at 300 rpm. These bearing factors are also very important when choosing a rotary for a particular type of drilling. An interesting comparison of the rotational requirements for various types of drilling is indicated by the following data: 100 revolutions per foot of very soft drilling, 200 revolutions per foot of soft drilling, 450 revolutions per foot of medium hard formations, 750 revolutions per foot of hard formation, and 1500 revolutions per foot of very hard formation.

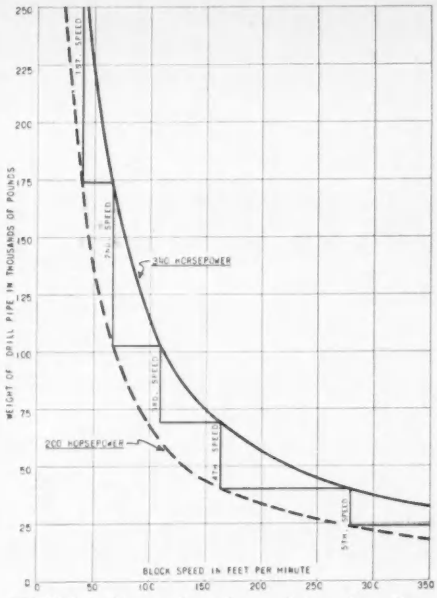

FIGURE 6. Power chart for an internal-combustion engine powered rig.

Auxiliary Equipment

The auxiliary equipment should be carefully considered in the design of a balanced rig so that adequate power and facilities are provided and not added as an afterthought, robbing power from other equipment. Usual items in this category are lights, mud screens, air compressors, blowout preventer actuating equipment, washdown pumps, mud agitators and bug blowers. These items require 50 to 75 horsepower on the larger rigs.

In holes having adverse sand conditions, power and equipment for removing the sand in addition to screens must be provided. On rigs where an auxiliary mud conditioning pump is not installed, mud mixing equipment of other types should be considered and power provided as required. There are many equipment aids to reduce crew fatigue such as power operated impact wrenches, tongs and slips which must be provided to obtain efficient operation and whose power requirements must not be overlooked in assembling a well-designed rig.

Another feature that should not be overlooked on a well-balanced rig is the safety of the crew. A considerable portion of this paper was devoted to discussion of safety factors which would improve rig performance, but which also enable the crew to work without undue hazard. In addition, there are many auxiliary pieces of safety equipment that prevent accidents and improve efficiency which should be incorporated into the ideal rig.

A balanced rig is also one which is carefully unitized to aid in obtaining low moving costs. Unitization should not go so far as to hamper drilling operations and thus create greater cost than the savings to be realized in moving. The packages into which the rig is broken down should be of legal size and of such bulk and weight that they can be handled safely and quickly with the transportation provided. Care should be taken to make the points of disassembly at such places that dirt cannot invade the open machinery. Proper access for servicing and repair of the equipment must not be neglected when making the rig more portable.

A balanced rig is also one that has as many of the parts standardized as possible. One type of engine should be used when feasible. Engines of the same bore and stroke, but varying in the number of cylinders or the addition of superchargers will provide a variation in power output of the engine units and decrease the maintenance problem. The use of similar bearings and sheaves in the crown and traveling block makes for better balance. The installation of one type of union or valve also aids economical maintenance. It is sometimes beneficial to standardize on one size of equipment, such as hooks, blocks, engines, etc., to enable an operator with several rigs of varying capacity to have balance between rigs rather than balance in one rig.

Summary and Conclusions

A study of the figures detailed in this article indicates that considerable care and judgment must be used in balancing the parts of a modern rotary rig to enable it to operate with the best economy for a particular type of drilling. The best economy is obtained by combining good drilling performance with high mechanical efficiency. Most complete rig assemblies that are balanced to suit particular conditions have a limited range of economical drilling depth and must be modified to suit a substantially different set of conditions. The rate of increase of loading as the depth increases necessitates that far more caution be administered in balancing the parts of a rig for deep drilling than for shallow drilling operations. High operating costs in the mud circulation system are often caused by the small size of the drill pipe in service as the sizes of drill pipe and tool joints commonly used do not provide the maximum in hydraulic efficiency. This efficiency usually can be vastly improved, but is often accompanied with an increase in ton mile service on the rig because of the larger and heavier drill pipe required. The most desirable balance between these two items of hydraulic efficiency and ton mile service constitutes the major problem in obtaining a balanced rig for engaging in deeper drilling.

TABLE 6

Example of Balanced Hoisting Equipment for California Type Drilling

	RATED DRILLING DEPTH (Feet)						
	3,000	6,000	9,000	9,000	12,000	12,000	15,000
Drill Pipe Size	5′ @ 19.5 Lbs.	5′ @ 19.5 Lbs.	5′ @ 19.5 Lbs.	5½′ @ 21.9 Lbs.	5′ @ 19.5 Lbs.	5½′ @ 21.9 Lbs.	5′ @ 19.5 Lbs.
D. P. plus 20,000 lbs., D. C., Lbs.	81,000	145,000	209,000	238,000	273,000	312,000	337,000
Hoist Input Horsepower	320	640	960	1080	1200	1400	1500
Wire Line Size (Improved Plow Steel, Hemp Center)	1″	1⅛″	1¼″	1¼″	1⅜″	1⅜″	1½″
Working Lines	6	6	8	10	8	10	10
Derrick Capacity, Lbs.	300,000	450,000	640,000	640,000	860,000	860,000	1,000,000
Derrick Height, Ft.	98	128	136	136	150	150	189
Crown Block, Tons	150	225	320	320	430	430	500
Traveling Blocks, Tons	110	175	260	260	360	360	420
Block Sheaves, Inches	36	42	48	48	60	60	60
Hook and Swivel, Tons	100	165	250	250	350	350	410
Rotary and Swivel, (Tons @ 250 R.P.M.)	40	75	105	120	140	155	170

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How to do it!

DRILLING HINTS

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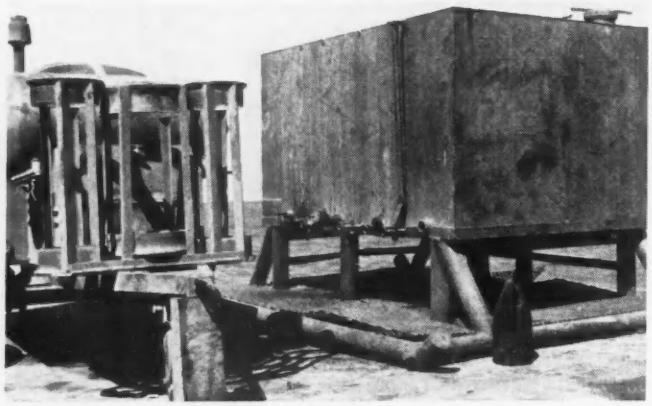
HOW TO—Check Level in Lubricating Tank

Two practical time-saving ideas relate to lubricating tanks, the other to welding. Shown at right is a portable lubricating storage tank of a type described in these columns in previous issues. It is partitioned off so that more than one type of lubricant can be stored. Rather than unscrew the filling cap at upper right of the vessel and insert a measuring stick inside to determine the oil level, an outside visual gauge is added.



The gauge glass is similar to those found on separators, and is connected at bottom and top to the tank. It is equipped with a regular needle valve at the bottom to equalize the fluid level inside and outside the tank. The glass is protected with a half-round of perforated sheet metal. With such a gauge, it is easy to determine when more lubricating oil should be ordered out to the rig.

Of considerable usefulness to welders is the cradle for hauling heavy acetylene and oxygen cylinders to and from the rig. Instead of having to load and unload them off pickup trucks, this method makes use of the trailer tongue of a portable air compressor. In the space just forward of the volume tank on the compressor trailer, framework is added to accommodate 3 cylinders: 2 oxygen and 1 acetylene. This framework is made from angle iron and casing thread protectors as shown. The protectors are welded top and bottom to the vertical braces and secured at the bottom front edge with a hinge.

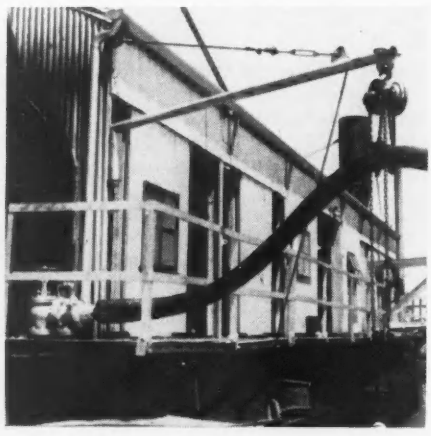
This hinge permits the entire frame to fall forward in a horizontal position for loading the heavy steel cylinders. Once the cylinders are in place, the frame is pushed back in the vertical position. These cylinders provide an extra supply of welding gas on rigs that are sometimes difficult to reach.

HOW TO—Hinge Walkways on Boiler Barges

Steel floating barges used in marsh drilling are costly, and the utilization of all available space is a must in design and operation of the equipment. Here is an idea that can save considerable space on a steel boiler barge which supplies steam to rigs drilling in areas where floating equipment can be used to advantage.

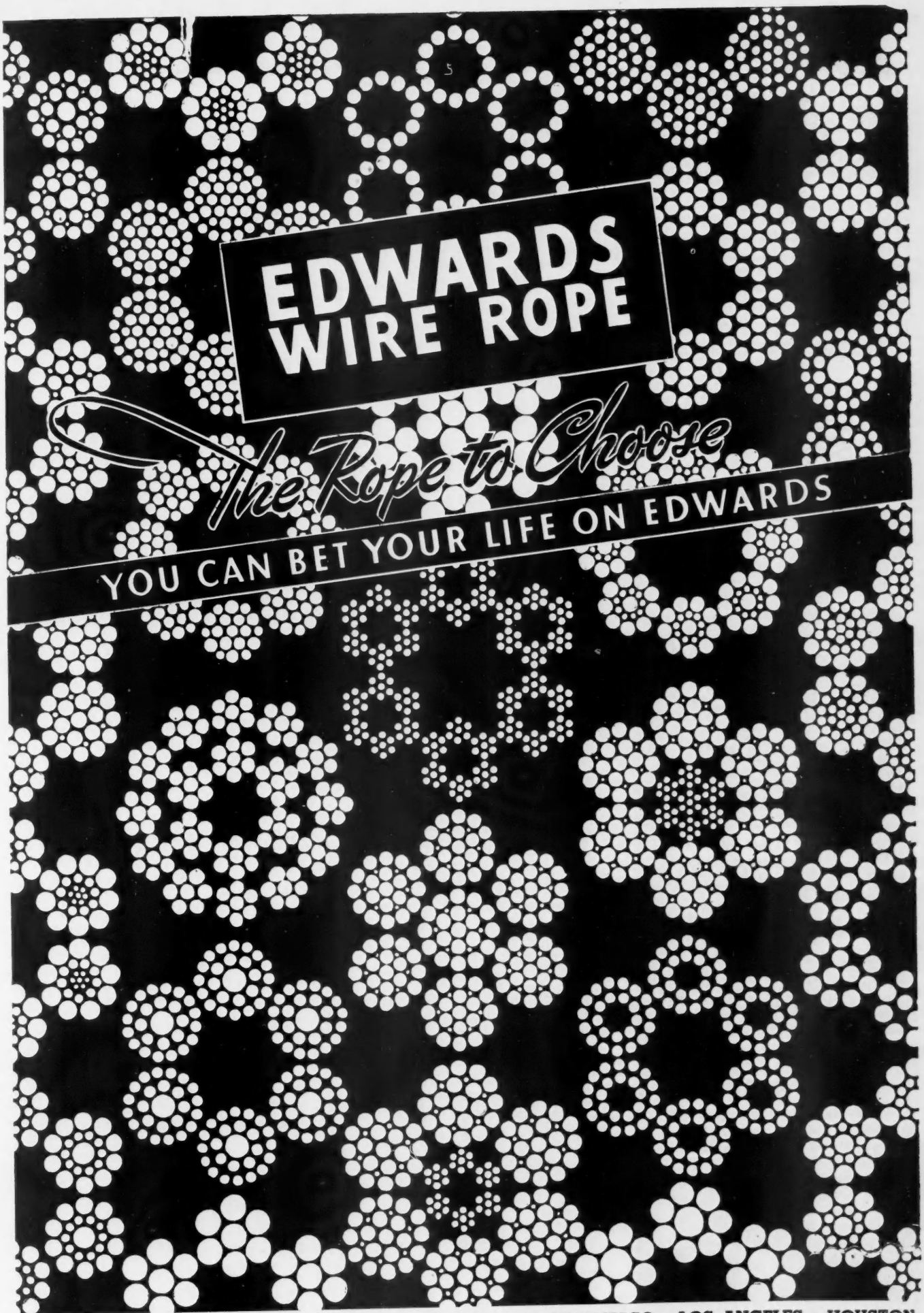
The steel housing erected over the barge can be extended the full width of the vessel without leaving a deck margin on either side for walkways. It is desirable, and almost a necessity, to provide outside walkways on this type barge so the derrickman and others can make their way hurriedly from one end of the barge to the other in case of emergencies requiring quick action.

The walkways on the barge illustrated



are hinged to the outside edge of the upper deck and braced with angle iron to the side of the barge. Framework for the walkway is of angle iron welded together and topped with expanded metal or steel floor sections. A handrail of strap steel can be bolted to the walkway in such a manner that it can be easily removed when necessary.

Such a hinged walkway not only provides an essential part of the boiler barge, but it permits full use of the upper deck of the vessel. If, during a rig move, it is necessary for a tug to tie onto the side of the barge, the walkway may be unbolted and lowered in a vertical position and the handrailings removed.



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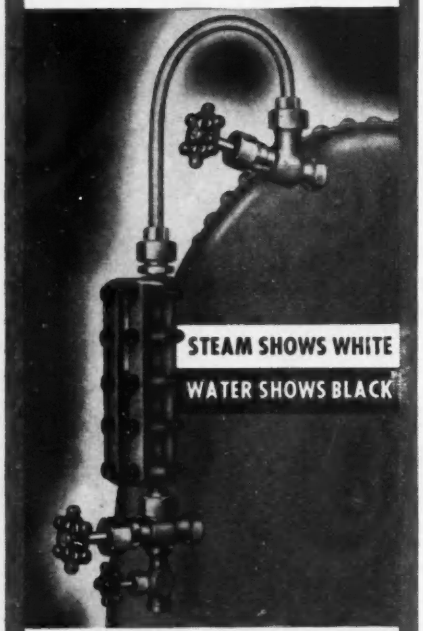

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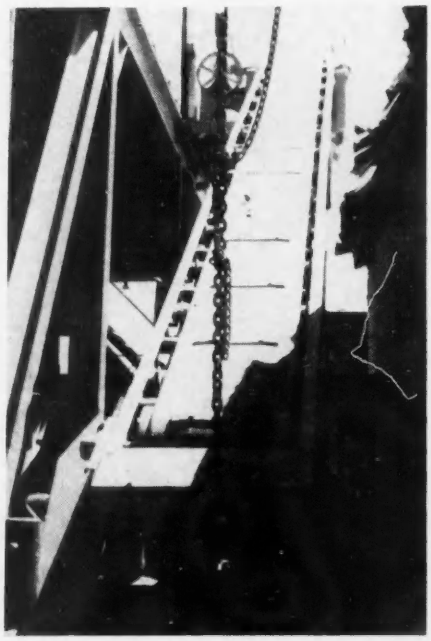
HOW TO—Unload Mud from Barge

The mud house of one large barge rig was located at the derrick floor level above the main deck of the drilling barge. To transfer hundreds of sacks of drilling mud, each weighing almost 100 pounds, from a supply barge represented a great deal of labor. To simplify this job and to speed the unloading operation, an endless fiber belt was installed. Sacks of mud were moved up the endless belt and taken off by hand at the upper deck level.



The loading device is shown resting on the mud supply barge deck. The device is essentially a rectangular steel framework which supports rollers on which the belt travels. The belt is driven by an electric motor controlled from the mud house on the drilling rig. Speed of the motor and the belt can be increased or slowed down as the need arises, depending upon the number of men available for the unloading operation.

The device is handled in much the same manner as a fire escape from a building. It is raised off the supply barge deck by a crane and is suspended in air by a chain. Casters on the lower end of the framework roll on the barge deck to compensate for rise and fall of the supply barge in the water. Cleats on the fiber belt prevent the mud sacks from slipping when the slope is fairly high. The device has proven very satisfactory, and its labor-saving features are popular with crews.

HOW TO—Improve Stairs and Ramp

A slight modification in design of the conventional fabricated walkway offers not only additional safety to those using it, but facilitates setting up and tearing down the unit at each location. Instead of making a separate unit of the stairway at the end of the walk, as frequently is done, it is built as an integral part of the walkway as shown.

Four horizontal members of the walkway are extended a few feet beyond the actual end of the walkway, and in this partially enclosed space a steel stairway is built. Made of channel iron, the stairway not only is sturdy, but is protected from possible injury from trucks or tractors, which, during the maneuvering involved in delivering or picking up materials, may damage or push aside a separately-installed stair unit.

A further improvement in the installation is the use of expanded metal which is welded to the stair treads and bottom landing of the stairway. A sturdy, permanent socket also is welded in place behind the stairway enabling the rapid placement or removal of the high line back-up post. The additional work and cost of this type of installation is offset by the fact that it will require no further care or maintenance as long as the walkway remains in service.

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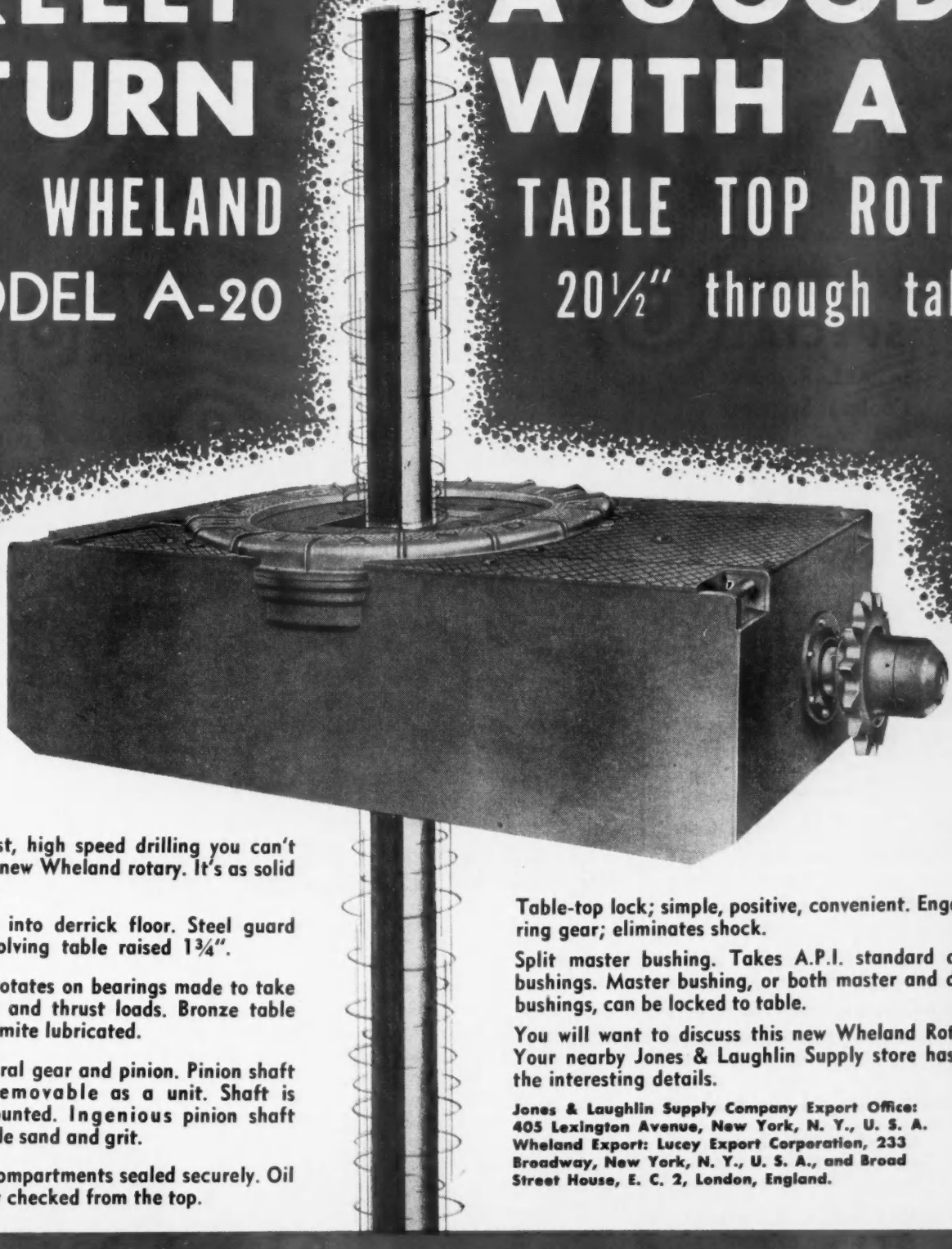

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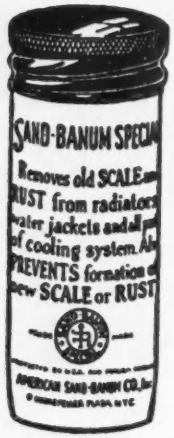
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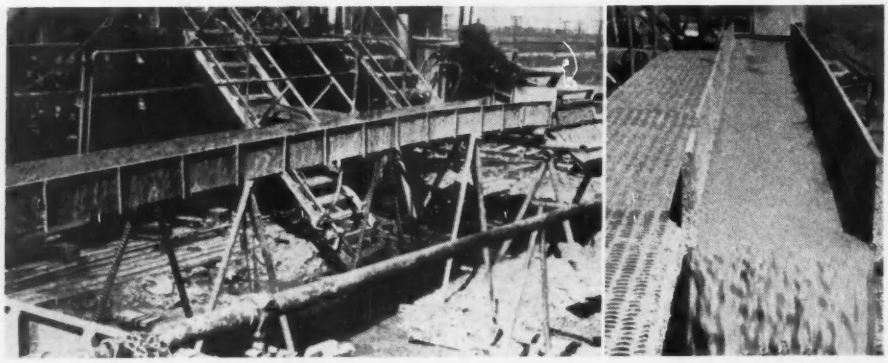

Where steel mud tanks are used in place of the conventional earthen pits, means must be provided to return the mud through an elevated ditch. On one medium-depth rig a simple and practical ditch carries the clean fluid from the shale shaker to the mud tanks. An elevated walkway is added to the side of the ditch to take advantage of the A-frame supports used to hold the mud ditch at proper level.

The shale shaker is elevated on an A-frame pipe platform so the drilling mud gravitates to the mud ditch and on to the pits. The ditch is made of thin plate steel reinforced at 3-foot intervals with angle-iron frames welded to the outside of the ditch. It is fabricated in two sections, each section equipped with a flanged face so that it may be bolted to the other section.

Simple A-frames are made by welding 3-inch pipe of proper height and wide enough to span both the ditch and the expanded metal walkway. If the ground is uneven, the supporting frames can be blocked up with timber. The complete assembly is light weight and highly portable, since it can be broken down quickly and carried by hand to loading trucks for moving to the next location. Use of the elevated ditch and mud tanks provides a mud which is not contaminated by surface soil.

HOW TO—Wash Crew Men's Clothes

The problem of dirty work clothes was solved on a power rig by a tool pusher who designed a dual-compartment wash tank to clean crew work clothes at the end of every tour.

The device is a rectangular steel tank tack-welded to a heavy pipe foundation and skid which facilitates moving. Each compartment is fitted with drain plugs so dirty water may be removed and replaced with a fresh supply. Heat to boil the water comes from gas burners below each compartment. Two burners per compartment supply enough heat to keep the water boiling. Gas is furnished from the rig fuel system through a long flexible rubber hose which simplifies its installation. Intensity of the flame may be adjusted by a control valve near the point where the rubber hose connects to the gas burner system.

The wash tank is equipped with bails at the top to speed handling by lifting equipment.

U-34

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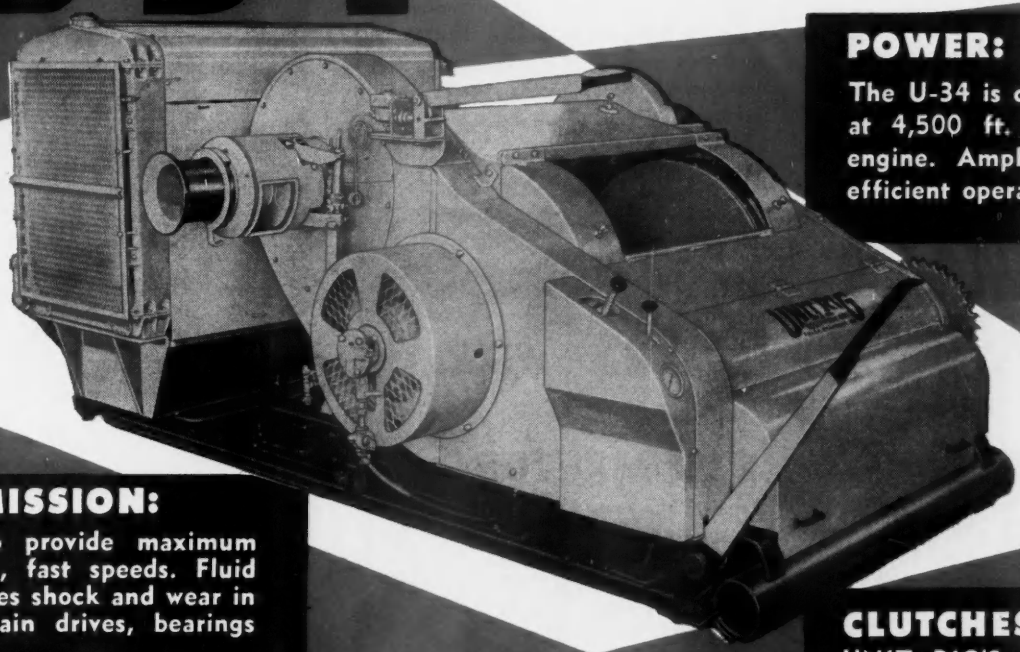

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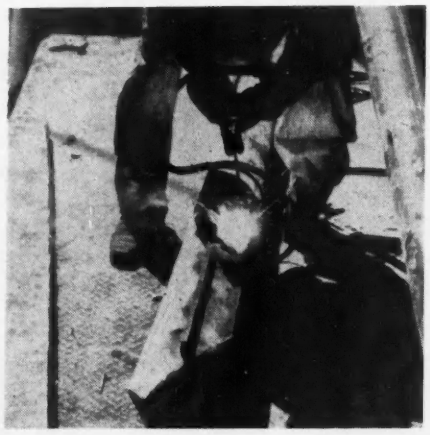
HOW TO—Add Ribs to Stabilize Sidetracking Tool

When drilling a directional hole in soft salt or other unconsolidated formations, it is possible for the whipstock to turn slightly after it has been set when the drill pipe is rotated. Although setting a whipstock on top of a cement plug or in harder formations may adequately prevent rotation of the tool, one directional drilling operator welded ribs to the whipstock as added insurance of performance.

When trouble was encountered in deflecting off a salt plug which was relatively soft and a high deflection angle



was desired, 5 steel ribs of square rod stock were welded to the lower section of the whipstock. One rib was welded down the center of the back side, while 2 were added to either side of the outer curved surface as shown. These ribs were tacked on and could be easily burned off with a cutting torch. As the ribs meshed into the soft material, they formed teeth which tended to stabilize the whipstock during sidetracking.

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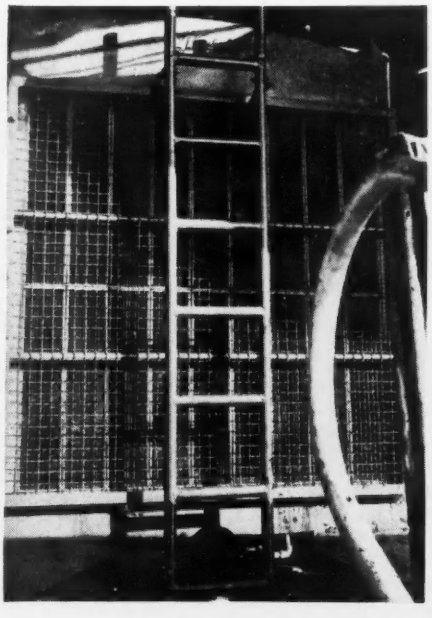

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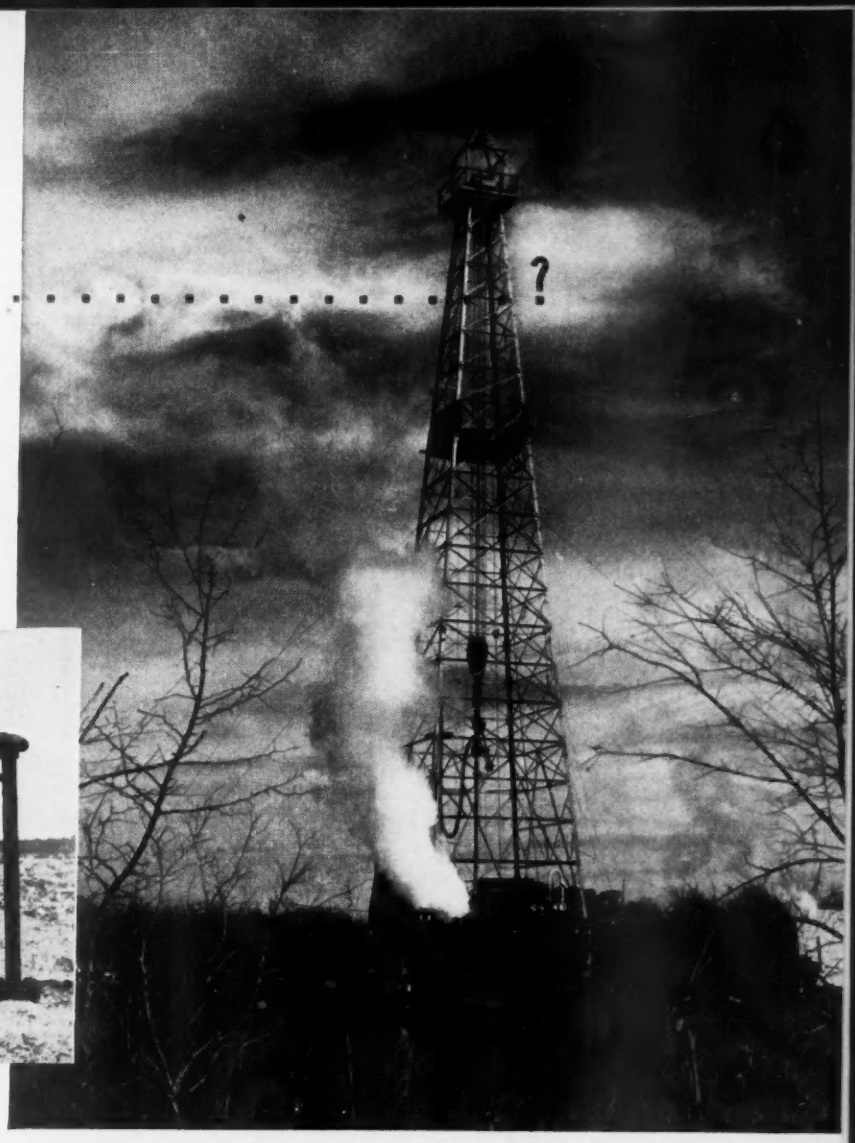

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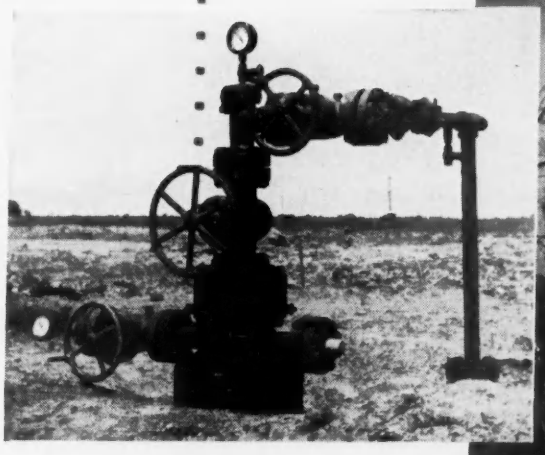

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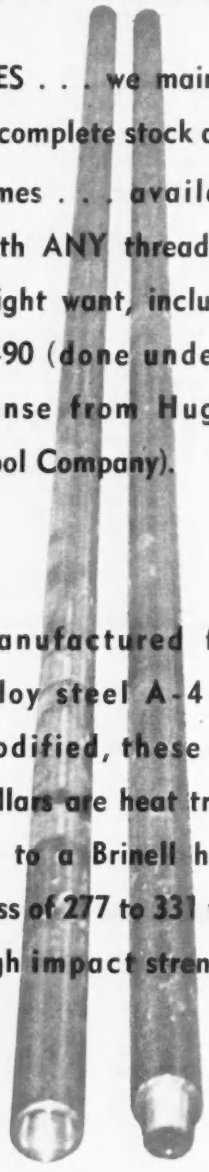

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engines require large radiators which are difficult to check unless steps or a ladder are provided.

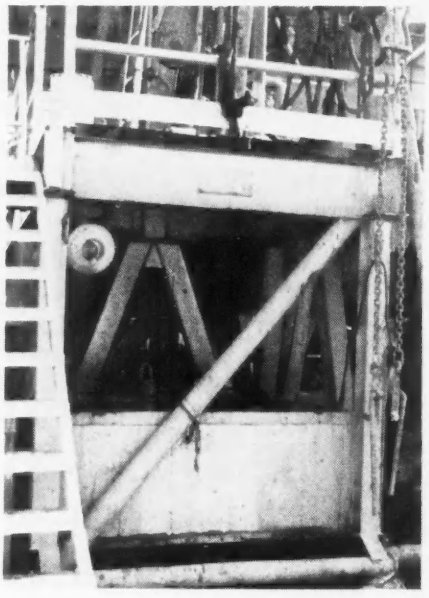
In order ot make certain that a ladder is available at all times, the one illustrated is bolted to the heavy grill-work protecting the radiator. Each radiator of the engine group is similarly equipped.

The ladder is made of welded 1½-inch pipe, and extends to the top of the radiator about 8 feet above floor level. On top of the radiator is mounted a special water fill line including a handy stop cock for instant use. When checking the radiators at the beginning of each tour, the mechanic can also fill them with water.

During rig moves these ladders may be easily removed from the radiators, but it is not necessary since they extend only about 10 inches from the protective grill.

HOW TO—Store Tools Below Floor

A sub-floor storage bin, access to which is through an opening cut in the derrick floor, is an important time-saving feature on one of the rigs of a California drilling contractor. In the corner to the right and opposite the driller's position, a 6-foot square steel bin was installed in the derrick substructure. A trap door in the derrick floor directly above the bin permits the lowering and picking up of equipment with the cat line and with a minimum of skidding and extra handling. Slips, tongs, elevators and miscellaneous spare fittings are lowered into the bin when the rig is to be moved and may be stored there during the periods that they are not needed. The bin is made of heavy sheet steel. It is 30 inches high and is reinforced at corners and top and bottom edges with 3-inch angle iron.

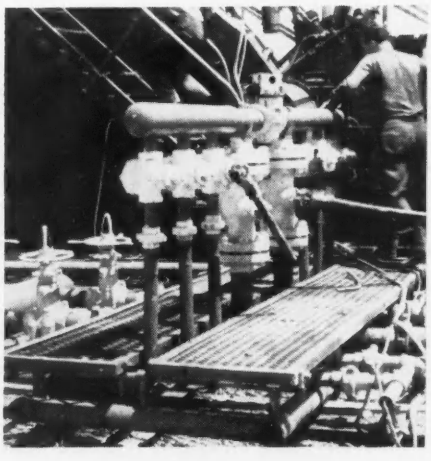


A flood light mounted just below the floor at one corner of the bin provides illumination at night. The man-hours saved during rigging up and tearing down operations amply repay the initial cost.

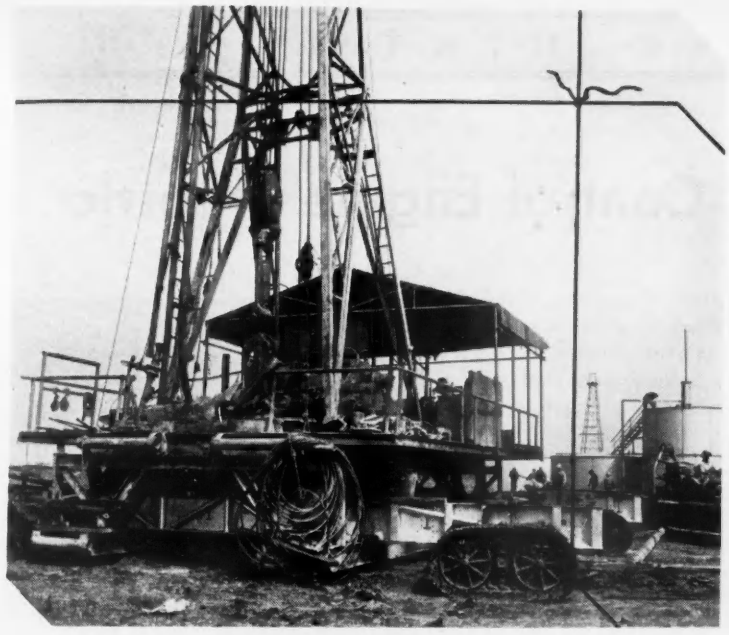
HOW TO—Unitize Fluid Manifold

A compact manifold to distribute drilling fluid from 2 sources to 6 destinations is both easy to clean and install. The manifold is supplied with a 3-inch pipe frame foundation that carries all of the equipment and provides a support for the distribution lines and the removable walks, one on each side.

Mud is delivered to the manifold by either of 2 sets of mud pumps through 2 pipe lines which pass through the manifold to the piping leading to the derrick standpipes. Each line from the pumps is fitted with a vertical riser connected to a common header above the foundation from which the distribution lines take off.



Walkways on each side of the manifold are built with individual angle iron frames to which the open work tread stock is attached to supply an easily



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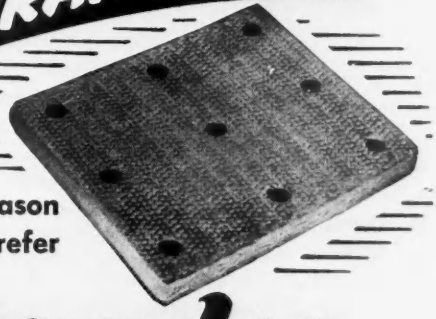

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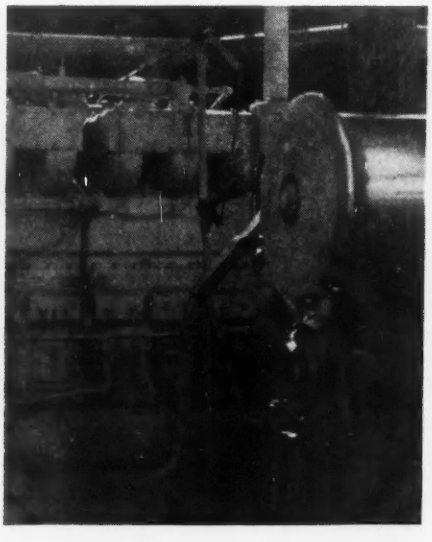
cleaned footing for men when opening or closing any of the valves in the setting. Short risers attached to the frame of the manifold carry horizontal cross pieces into which the frames of the walks are placed to hold them solidly in place. Connections on all lines are immediately outside the frame of the manifold support so that lines can be detached or connected easily, and the manifold is ready to move intact.

HOW TO—Control Engine Throttle

The location of heavy-duty internal combustion engines behind the drawworks complicates the manner in which the throttle can be positively controlled. With air controls, the problem is simplified; however, when a direct mechanical linkage is desired and the carburetor is located on the back side of the engine, the control mechanism becomes more involved.



A mechanical linkage such as that shown makes it possible to control the throttle of an engine in a manner similar to the throttle controls on a steam rig. The linkage illustrated merely provides a step over the engine, yet maintains the rotation of a rod for adjusting the engine speed. The driller is provided with a throttle wheel which is connected to a long steel rod which terminates in a bearing socket behind the drawworks and just in front of the engine. This socket rests on a vertical pipe support which also serves as a pivot rest for a transfer rod going over the top of the engine.

A short lever on the throttle rod from the driller's position is connected by a short linkage to a rod resting in the top bearing rest of the vertical pipe support. At this point, the angular displacement of rotation is shortened by a longer lever arm attached to the over-engine throttle rod extension. On the back of the engine and just above the carburetor, a similar socket rest for the rod is provided so that a short linkage connects the rod lever to the throttle valve. This simple method of transferring throttle wheel rotation to actuate the butterfly valve on the carburetor is effective, yet simple and inexpensive to make.

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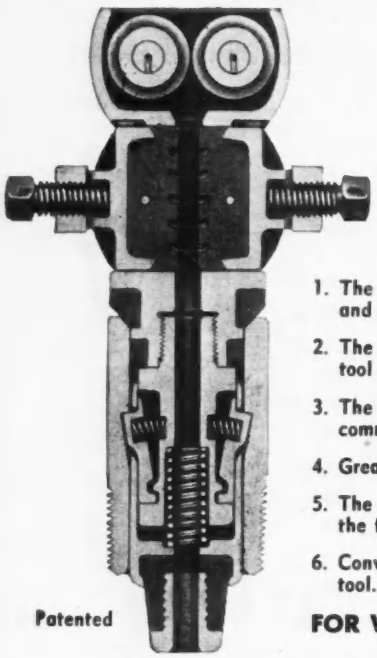

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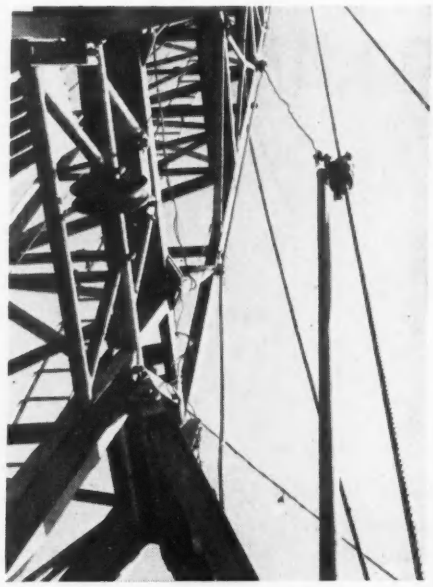
HOW TO—Mount Wire Rope Guide

The problem of mounting rotary wire rope guides on large rigs is simplified since the feedoff from the drawworks is inside the derrick and the guides can be suspended from the derrick legs. It is more difficult to guide the rotary line on cantilever type derricks because the wire rope travels from the drawworks drum up to the crown block outside the derrick structure.

Because there is considerable whip in the rotary line if it is not equipped with guides, the method shown was employed to mount the wire rope guide. Just in front of the drawworks drum a hole was drilled and a joint of salvaged drill pipe was inserted so that it was supported from below the derrick floor and extended about 18 feet into the air above the floor.



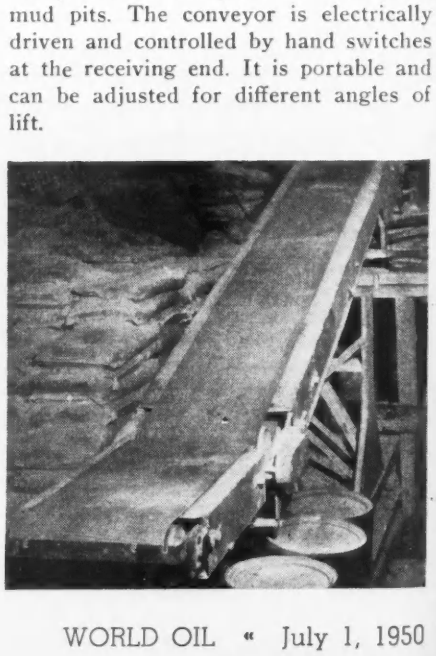
To the top of this pipe was attached a wire rope guide by means of a short length of chain as shown. A short length of steel cable was also attached to the guide and to the second girt to serve as a support in case the chain failed. The support was simple to install and serves effectively to reduce the amount of whip in the wire rope as it is fed out. It is high enough above the drawworks so that it will not interfere with spooling of the wire line.

HOW TO—Handle Dry Mud Material

Electrically-driven conveyors make it possible to reduce the time and labor formerly required to stack dry mud materials in the mud house of drilling barges and offshore platforms, and also permit the rapid mixing of weighing materials into a special sump to which the mud pump suctions are connected.

Illustrated is an endless belt conveyor specially designed to handle sacks of dry mud. It is essentially an endless belt running over two solid shafts at each end of a rectangular framework which can be adjusted at either end for height. In the case shown, the conveyor has an extension added in the foreground so that sacks of mud can be placed on the extension and manually pushed onto the moving belt leading to the elevated platform.

At the elevated platform is a mixing hopper which feeds into a steel sump beneath it. With 2 men working at the hopper and 2 men feeding the sacks to the conveyor, a considerable amount of weighting material can be added to the mud system in short order. The heavy fluid in the sump can either be pumped directly into the standpipe in case a heavy slug of mud is desired, or the heavy mud can be jetted into the main mud pits. The conveyor is electrically driven and controlled by hand switches at the receiving end. It is portable and can be adjusted for different angles of lift.



Pumping Equipment Selection

for Lowering Lifting Cost

By KENNETH N. MILLS

Product Manager, Oil Field Sales
International Derrick & Equipment Company, Columbus, Ohio

THE AUTHOR discusses types of down-the-hole equipment and its effect on the surface units; developing speed and depth limitations for certain designs and setting forth desirable pumping and sucker-rod combinations for wells requiring tapered rod strings to effect maximum lift with minimum string stress.

THE cost of producing an oil well can be influenced by the choice of surface and subsurface lifting equipment and operating methods. Minimum lifting costs should be achieved when all equipment is selected to cope with the prevailing well conditions and with sufficient capacity to produce the desired fluid volume in the most economical period of time. To achieve maximum operating efficiency it is essential to have accurate information on the type of drive in the producing formation and the characteristics of the well fluid. The nature of the driving force and the formation will be a factor in determining the ultimate lift and volume of fluid to be produced. The characteristics of the well fluid will influence the type and grade of subsurface equipment required to achieve minimum lifting costs.

The probable production rate should be established before tubing is run into the well because the tubing size will determine the maximum pump bore size. To achieve minimum equipment cost, the production rate should be kept at an economical minimum, because it is the key factor in determining the size of the surface equipment. The selection of a production rate involves some unknown variable factors, as it is influenced by market demand, water production and the availability of lease labor. If lease labor is available over a 16-hour period, a desirable production rate would be one which will produce the required fluid in about 12 hours. This would allow some time for equipment and well maintenance. The effect of production rate on equipment loads and power demands is shown in Figure 1. This chart shows the variation of production rate, pumping unit peak torque loads, horsepower, and polished rod loads with plunger diameter for a 3500 foot fluid lift. In this chart it will be noted that the equipment loads and therefore sizes increase rather rapidly as the plunger diameter is increased.

Pumping Speed

When the production rate is established, a practical combination of plunger diameter, stroke and pumping speed must be selected to achieve this production rate. As the rate of production is a direct function of pumping speed, it might appear that the most economical installation would be achieved, if a high pumping speed were employed. However, as the load is reciprocated, inertia forces place a limitation on the maximum practical pumping speed. The maximum practical pumping speed is one that will not cause the polished rod hanger to "run away from" the polished rod clamp on the down portion of the stroke cycle. If a higher pumping speed is used the polished rod hanger and clamp will part, and when they contact later in the stroke cycle, the sucker rods and pumping machinery will be subjected to damaging shock loads. The approximate value of the maximum pumping speed is expressed by the following equation and is shown graphically in Figure 2.

$$N = \sqrt{\frac{60{,}000}{L}}$$

where:

N = Maximum number of strokes per minute
L = Length of strokes, inches

This equation assumes the friction between the rods and tubing and in the pump to be normal. If this friction loss is increased by a crooked hole, an improperly set packer, excessive pump friction or paraffin, the maximum pumping speed must be reduced to allow for the reduced rate of sucker rod fall caused by these conditions.

As most sucker rod failures are the result of fatigue, maximum sucker rod life will be realized when operating at a speed below the maximum pumping speed. Sucker rod life will increase as the pumping speed is decreased, because reducing the pumping speed decreases the magnitude of the dynamic stresses, decreases the range of stress, and decreases the number of stress applications. Reducing the dynamic loads increases sucker rod life because it decreases the total load imposed on the rods. Research work in the field of fatigue resistance of steel has shown that the service endurance limit of steel is a function of the range of stress, and the service endurance limit increases as the range of stress is decreased. J. O. Almen of the General Motors Corporation Research department published[1] the chart shown in Figure 3 which gives the relationship between range of stress and endurance limit. In this chart it will be noted that the endurance limit increases as the stress range approaches zero. In the sucker rod problem the range of stress is the difference between the maximum

and minimum well loads. As the values of these 2 loads are functions of speed, and the maximum well load decreases and the minimum well load increases as the pumping speed is decreased, the range of stress decreases as the pumping speed is reduced. This reduction in range of stress increases the service endurance limit of the sucker rods. Reducing the number of stress applications per unit of time will increase the service life of the sucker rods, because all fatigue failures occur after the material has been subjected to some definite number of stress applications.

Production Rate

The production chart shown in Figure 4 can be used to select stroke length and pumping speed and plunger combinations to give the desired production rate. This chart is based on 80 percent efficiency and the stroke length lines do not extend beyond the maximum pumping speed for each stroke length. The solid portions of the stroke length lines correspond to reasonable pumping speeds and are limited to speeds which should give good sucker rod life. The dotted portions of the stroke length lines cover the pumping speeds between those desirable for good sucker rod life and the maximum pumping speed. The stroke and speed combinations covered by this section of the curves should not be used, if maximum economy is to be achieved.

The size and type of pump selected can influence the frequency and cost of servicing the well. If the tubing size is established and a large pump bore is selected, a tubing type pump may be required. This type pump construction affords the maximum plunger diameter for a given size of tubing because the pump barrel is attached directly to the lower end of the tubing. In this type pump construction the plunger and traveling valve are attached directly to the lower end of the rod string and are lowered into well on the rod string. The standing valve assembly can be fitted with a number of devices used to pull it out of the well with the rod string. A typical tubing pump with a cup type plunger, without a standing valve puller, is shown in Figure 5. This type of pump can be fitted with a metal plunger, which has the advantage of longer life and lower friction. When it is fitted with a metal plunger it should be fitted with an extension nipple as shown in Figure 6. The extension nipple will permit the plunger to stroke out both ends of the barrel. This will distribute wear evenly over the length of the barrel and permit the installation of an oversized plunger to compensate for wear. Also, it will prevent the accumulation of gyp and salt in the unused portion of the barrel which might interfere with pulling the

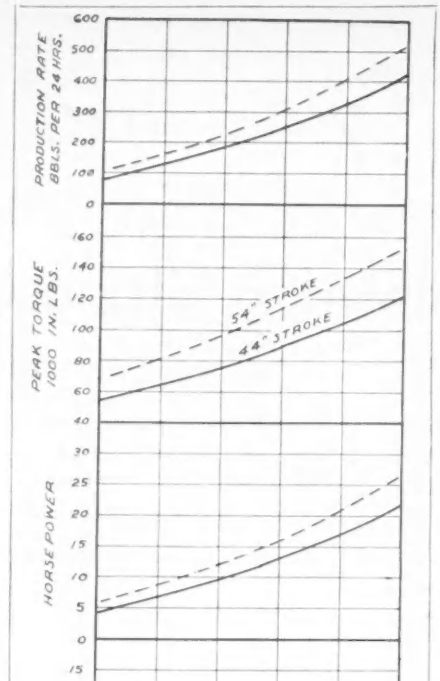


FIGURE 1

plunger or increasing the stroke length.

The rod type pump was developed to reduce the cost of well servicing to repair the pump. It reduces servicing costs, because the entire pump assembly, consisting of barrel, plunger, standing and traveling valve, is lowered into and removed from the well with the sucker rod string. The pump assembly rests in and seals off on a seating shoe or nipple in the tubing string. If the tubing string is fitted with a working barrel, it can be seated in the top of the working barrel. This type pump can be removed as an assembly by pulling the rods, and it is not necessary to pull the tubing to replace the pump barrel. As all pump parts must be removed to service the pump, the possibility of leaving defective parts in the pump, requiring a second repair job, is reduced to a minimum. Also, the possibility of damaging the pump plunger during its trip down the tubing is eliminated, because it is protected by the barrel. As the entire pump assembly must pass through the tubing, its maximum bore for a given size of tubing is less than that of a tubing type pump.

Rod type pumps have been developed in 3 basic types of construction and 2 types of barrel construction to cope with varying well conditions. The constructions are (1) stationary barrel with top hold-down, (2) stationary barrel with bottom hold-down, and (3) traveling barrel. Each type pump is available with either a full barrel or a liner type barrel. The liner barrel construction is better suited to hard pumping service because the liners can be made of hard abrasion resistant materials. A typical stationary full barrel pump with a top cup hold-down is shown in Figure 7. The plunger is shown with 2 traveling valves. These pumps are available with any practical number of traveling and standing valves, and cup and mechanical type hold-down. A stationery liner barrel pump with a bottom mechanical hold-down is shown in Figure 8. A traveling liner barrel pump with a mechanical hold-down is shown in Figure 9. Each pump has been developed to produce specific types of well fluids and when properly applied will give maximum service.

Top Hold-Down Pump

The top hold-down type pump is designed to produce gassy or sandy fluids in wells of moderate depth. This pump is suited to wells producing sandy fluid because the fluid is discharged from the pump at a point just above the hold-down. As the fluid passes over the hold-down, sand cannot settle between the pump and the tubing and stick the pump. If the tubing perforations are located just below the seating shoe, the effectiveness of the gas anchor can be increased, because its effective length will be increased by the length of the pump. This type pump is not well suited to deep wells because the outside of the pump barrel is located in fluid under relatively low pressure, and the pressure of the fluid column in the tubing tends to expand the barrel and increase the clearance between the barrel and plunger. This will cause a slight loss in efficiency when producing deep wells.

The bottom hold-down pump is suited for use in deep wells producing sand-free fluid. As the seal point is located at the bottom of the pump, its barrel is in equalized fluid pressure or under a pressure condition which tends to reduce the clearance between the barrel and plunger. This condition is favorable to minimum slippage and high pump efficiency. As the seating device is on the lower end of the pump, it can be seated in an existing working barrel. This type pump should not be used in wells which produce sand because the sand will settle in the space between the tubing and the pump body. If this sand becomes tightly packed it will stick the pump in the tubing and may necessitate a stripping job or cause the rods to be overstressed in pulling the pump.

The traveling barrel type pump is well suited for use in wells producing sandy fluid. In this pump design the traveling

valve also acts as a sand check valve and keeps sand from settling on top of the plunger when the well is shut down. The hydraulic action of the pump barrel will displace any sand which settles between the barrel and the tubing. The pressure differential across the barrel is the same as that of the bottom hold-down type pump and therefore it is well suited to deep wells.

All types of pumps are available with cup, ring or metal plungers. The cup and ring type plungers have the advantage of lower first cost. However, they have the disadvantage of high friction losses and in general shorter life when compared to a metal plunger. The exact amount of the friction losses is a function of the plunger fluid load, cup stiffness, fit of cups or rings in barrel and number of cups or rings. The 3 dynamometer cards shown in Figure 10 illustrate the effect of plunger friction on well load. In this series of tests, a ring type plunger was used and the number of rings was reduced by ½ for each test. In each test the production remained constant. In the case of cup type plungers, cup stiffness can have a similar effect on the rod loads, as the fluid load expands the cups against the wall of the barrel. If the cups are extremely soft, excessive friction will result and the rod load will be increased. This can cause premature sucker rod failures and will cause excessive power consumption.

Control of Gas

If the well produces a relatively large volume of free gas, the pump installation should be designed to reduce the volume of gas entering the pump and the pump should be selected to give high compression ratio. The amount of gas entering the pump can be reduced by using an efficient gas anchor. For maximum efficiency the gas anchor should be made of the largest possible pipe and the gas bleeder holes should be located just under the pump seating shoe or standing valve seat. If a rod type pump is used, this practice will permit the pump body to act as an extension to the gas anchor. If free gas enters the pump, it must be compressed to a pressure equal to the pressure of the fluid column in the tubing before the traveling valve can open. If the ratio of the pump volume at the top of its stroke to the volume at the lower end of its stroke is too low, and the pump is filled with gas, the pressure will not increase sufficiently to open the traveling valve and the pump will be gas locked. The above ratio is the compression ratio of the pump. Considering a given pump size, the maximum compression ratio is obtained, when the pump plunger is fitted with a valve on its lower end, and the traveling and standing valves are spaced close together on the lower end of the stroke. The compression ratio is also affected by the pump plunger diameter and the stroke length. Increasing the plunger diameter will increase the compression ratio of the pump and improve its efficiency in handling a gaseous fluid. Also, increasing the stroke length will

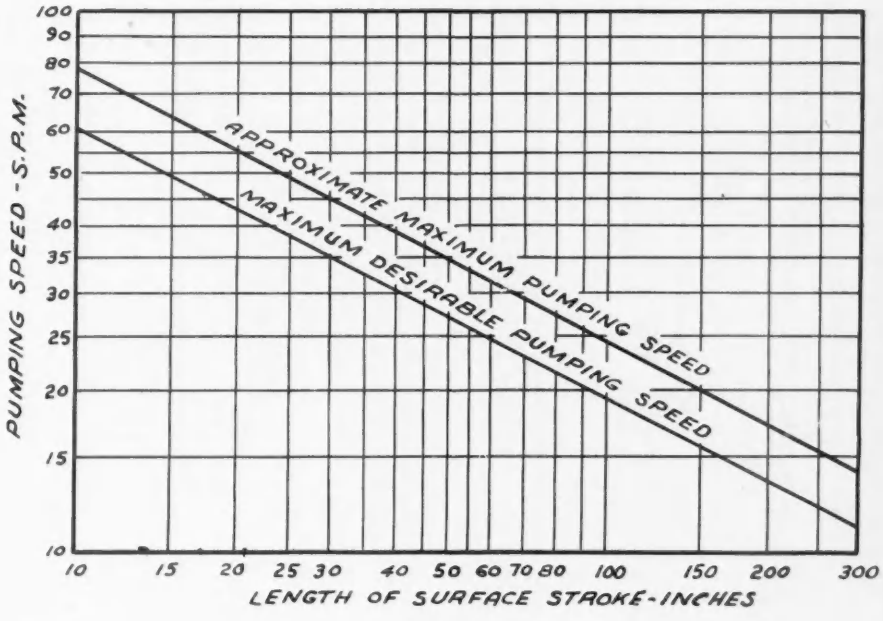
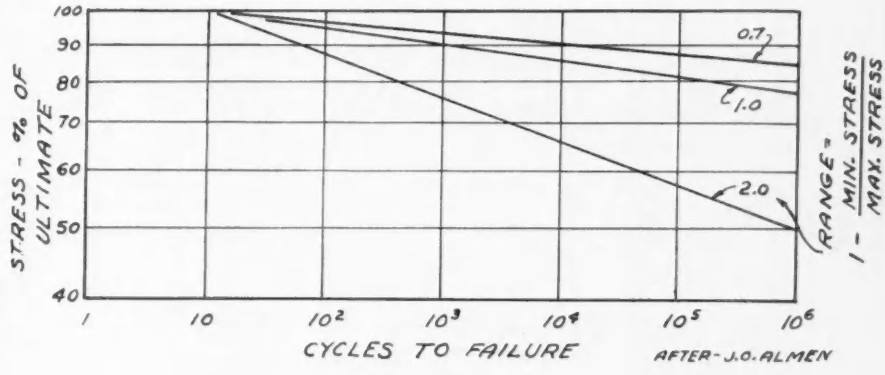

PUMPING SPEED - S.P.M.
APPROXIMATE MAXIMUM PUMPING SPEED
MAXIMUM DESIRABLE PUMPING SPEED
LENGTH OF SURFACE STROKE-INCHES

FIGURE 2



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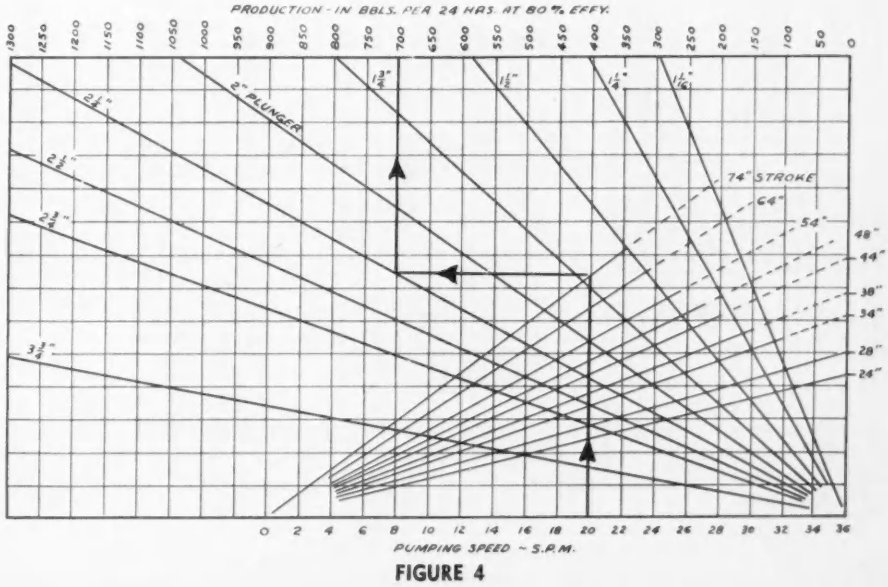

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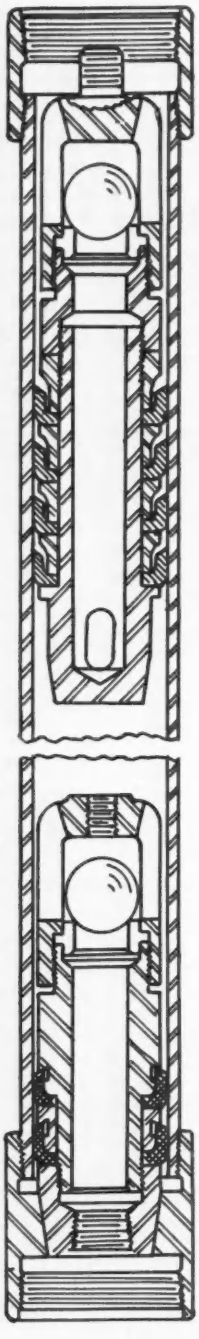
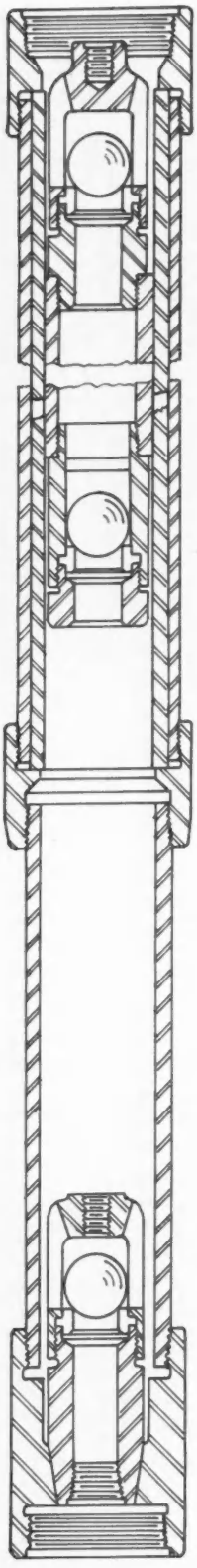


FIGURE 5



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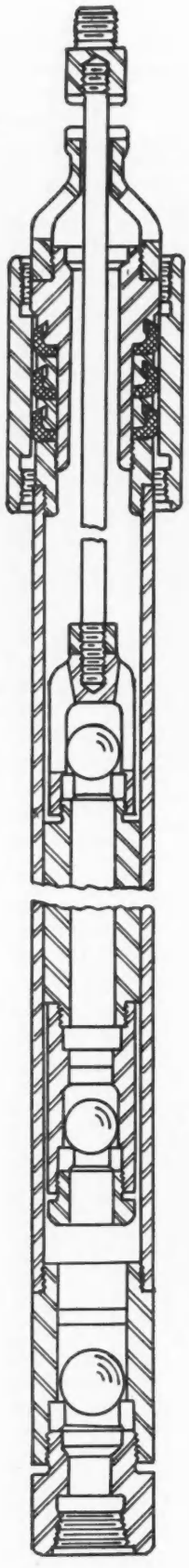


FIGURE 7

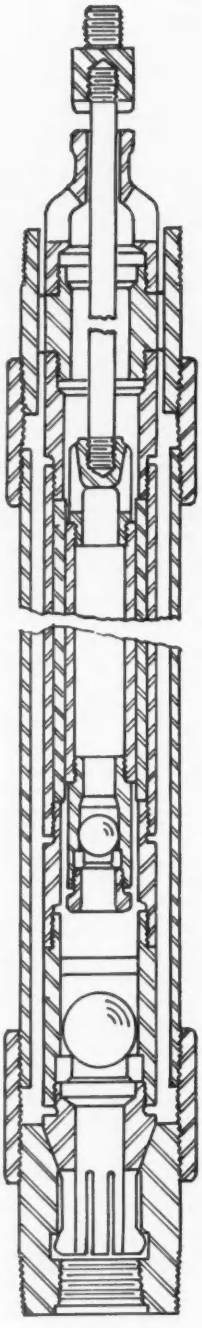


FIGURE 8

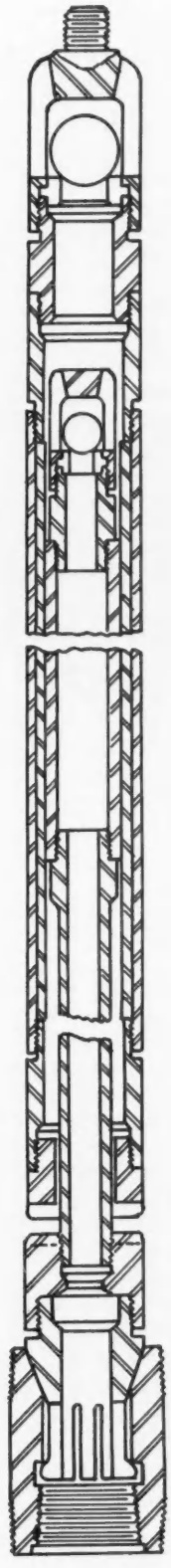
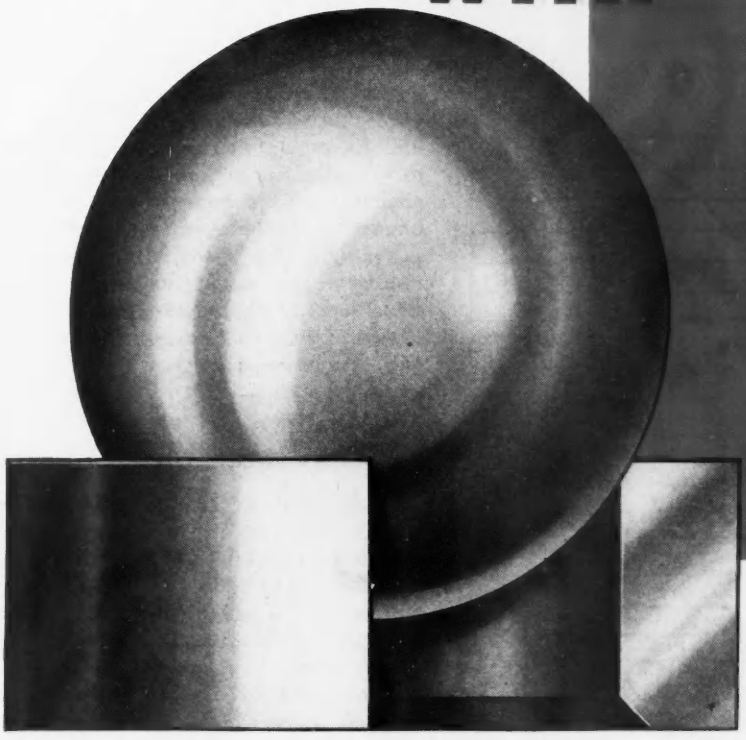


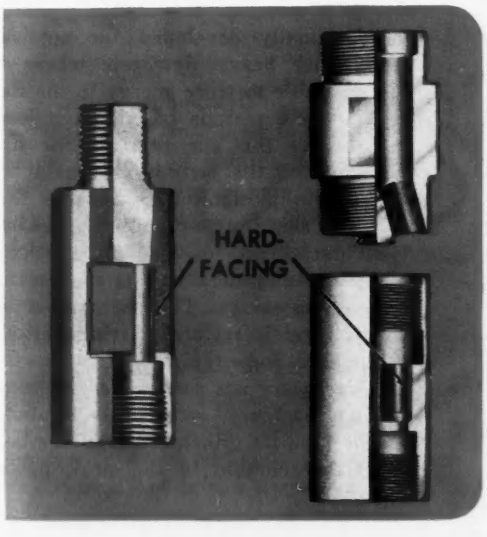
FIGURE 9

Troubled with

- corrosion?
- abrasion?
- ball pound?
- high pulling cost?



OILMASTER **TUNGSTEN CARBIDE SEATS AND BALLS** are made from solid tungsten carbide, *the hardest metal known to Industry*. These seats and balls will not cut from fluid wash when subjected to extreme pressures—will not wear from the abrasive action of sand—will not hammer out from extreme fluid pound—will not pit from the action of corrosive well fluids. This ball and seat combination provides the most perfect valve ever built.



OILMASTER **TYPE 100 CAGES** are built from *highest quality chromium alloy steel.* The two-piece construction in these blind cages provides maximum adaptability and economy. Fabricated with hard faced ball guides (tungsten carbide) these cages will not batter out from ball spin. Their resistance to severe corrosion assures a perfectly guided ball action for the life of the pump.

oilmaster
Tungsten Carbide Seats and Balls
and
oilmaster
Type 100 Cages

Especially Designed To Eliminate Pulling Jobs Caused By Valve Or Cage Failures

If you are troubled with these problems, your OILMASTER representative will prove that OILMASTER Tungsten Carbide Seats and Balls and Type 100 Cages will lower your lifting costs.

OILMASTER PRODUCTS

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increase the compression ratio of the pump and improve the efficiency in producing a gaseous fluid. A gas-locked pump will subject the sucker rods and the surface machinery to adverse loads, and it will decrease the over-all efficiency of the pumping installation. The effect of a gas-locked pump on the sucker rod load is shown in Figure 11. In this dynamometer card it will be noted that a gas-locked pump will subject the sucker rods and surface machinery to unnecessary shock loads.

The size and type of sucker rods will depend on the magnitude of the well load and the corrosive nature of the well fluid. If the well fluid is corrosive an alloy grade of sucker rod should be used. To achieve maximum benefit from alloy sucker rods in a corrosive well, the sucker rods, pony rods, sucker rod couplings and polished rod should be made of the same alloy. Using sucker rod strings composed of different grades of material in a corrosive fluid can set up galvanic currents which will cause premature rod failures.

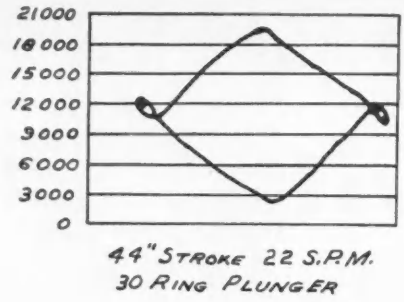
As the polished rod load is composed of the weight of the rods plus the fluid and dynamic loads, it can be reduced by using a rod string composed of 2 or 3 sizes of sucker rods. Rod strings composed of 2 sizes of sucker rods are usually considered for depths more than 4500 feet and rod strings composed of 3 sizes of sucker rods are used in wells more than 6500 feet deep. Naturally, these depth limitations are arbitrary and tapered rod strings can be used in wells of any depth. Maximum advantage in sucker rod life and load reduction is achieved when the tapered sucker rod string is designed to give equal stress in the top section of each rod size. The double and triple tapered sucker rod string proportions shown in Table 1 are based on equal stress and can be used to design tapered sucker rod strings.

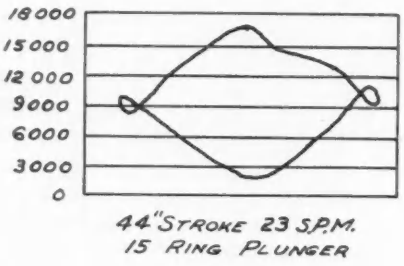
Lifting costs may be materially influenced by the type of power source selected for the pumping unit and the care used in selecting and applying the power unit. The type of power unit will depend on the type of lease labor available, well locations, the cost of fuel or power in the area, company policy, and other variables. After a type of power is selected, the amount of power required to pump the well must be estimated. The amount of power required to pump an oil well can be determined with the equation

$$Hp = \frac{P \times D}{68{,}000 \times K}$$

where:

P = Production based on 80 percent pump efficiency, bbls. per 24 hrs.
D = Depth to pump, feet.
K = Application constant for type of power used. Values of K follow.





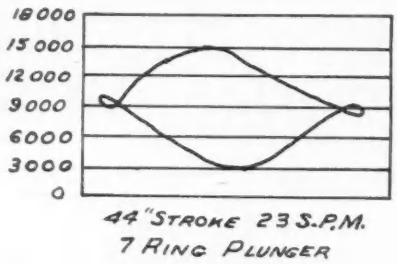


FIGURE 10

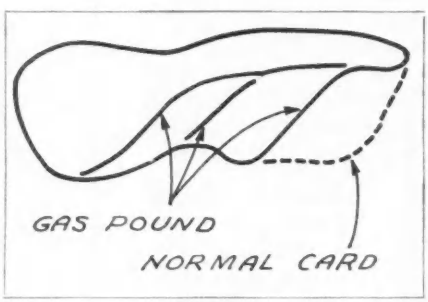


FIGURE 11

Table 1

Percentage Constants for Two Combination Tapered Rod Strings

Plunger Diameter	5/8"—3/4" % of 5/8"	3/4"—7/8" % of 3/4"	7/8"—1" % of 7/8"
1 1/16	68.3	73.5	77.8
1 1/4	65.3	71.6	76.6
1 1/2	60.5	68.5	74.5
1 3/4	54.8	64.9	72.1
2	48.3	60.7	69.3
2 1/4	40.9	56.0	66.2
2 1/2	32.6	50.6	62.7
2 3/4	23.4	44.8	58.8

Percentage Constants for Three Combination Tapered Rod Strings

Plunger Diam.	5/8"—3/4"—7/8"		3/4"—7/8"—1"	
	% of 7/8"	% of 3/4"	% of 1"	% of 7/8"
1 1/16	23.3	26.1	19.5	22.3
1 1/4	25.6	28.6	20.9	23.9
1 1/2	29.1	32.6	23.2	26.5
1 3/4	33.3	37.3	25.9	29.6
2	38.1	42.7	28.9	33.1
2 1/4	.....	.....	32.4	37.1
2 1/2	.....	.....	36.3	41.6

Single cylinder engine	K = 1.0
Multiple cylinder engine (Based on manufacturer's fully equipped power unit)	K = 0.65
Multiple cylinder engine (Based on API pumping rating for fully equipped power unit)	K = 1.0
Electric motor (General Purpose)	K = 0.70
Electric motor (High Slip)	K = 0.85

If a high speed engine is used as a power source, its operating speed can have a material influence on its service life. Experience indicates that satisfactory engine life will be achieved if the engine speed is limited to a maximum piston rubbing speed of 1000 feet per minute. The piston speed is a function of engine stroke and engine rotational speed. The relationship between engine stroke, engine rotational speed and piston speed is shown graphically in Figure 12.

Electric Power

If the well is pumped with electric power, the type of electric motor can have a material effect on operating costs and the loads imposed on the speed reducer. Electric motors are available in 3 basic types: general purpose, high torque normal slip and high slip. The electrical and mechanical characteristics of these 3 types of motors are shown in Figure 13. The important difference is their speed-torque characteristics. This relationship is usually expressed as the percent slip at full load. General purpose and high torque motors usually have a slip of 2 to 3 percent at full load and high slip motors have a full load slip of 8 to 10 percent. The high slip motor was originally developed for applications using heavy flywheels where it was desirable to store energy in the flywheel during periods of minimum load and remove this energy from the flywheel during the periods of peak load. The high slip motor accomplishes this result by shirking the load, i.e., slowing down during periods of maximum load and permitting the flywheel to give up some of its energy. The energy lost by the flywheel is restored during periods of low load. Some typical applications for this type motor are punch presses, shears, forging machines, etc. On applications of this type its principal advantage is a material reduction in the peak power demand.

As the pumping load cycle imposes a variable load on the motor and the pumping unit contains some flywheel effect, it is reasonable to expect the high slip electric motor to have advantages when applied to the pumping problem. Field tests (2) have shown that the high slip motor has the following advantages over normal slip motors when applied to oil well pumping:

1. Lower peak power demand.
2. Lower average power consumption.
3. Less motor heating due to lower R.M.S. current.
4. Less fluctuation in power demand on distribution system.
5. Easier starting due to high starting characteristics of high slip motor.
6. Lower peak load on pumping unit driving system (belts and speed reducer).

The electrical results on a series of tests made on a pumping unit with normal and high slip motors is shown in Table 2. Comparative recording watt meter charts are shown in Figure 14. In these electrical data it will be noted that the peak power delivered to the pumping unit was lower when the high slip motor was used, indicating that it reduced the torque load imposed on the speed reducer. However, the polished rod load was not changed sufficiently to be significant. This is the result one should expect because the principal factors influencing the magnitude of the well load are not appreciably affected by small changes in the speed characteristics of the surface machinery.

Table 2

Motor Type	Normal Slip	High Slip
Line voltage	484	492
Max. current, amp.	12.7	6.4
Min. current, amps.	10.3	3.8
Max. power factor, %	50.7	81.8
Min. power factor, %	31.5	76.0
Max. power input, KW	5.2	3.8
Min. power input, KW	2.0	2.0
Average power input, KW	3.6	3.1
Pumping speed S.P.M.	16	16.5

To assure minimum damage from uncontrollable well conditions such as stuck pumps, sucker rod failures, and pumping off, the pumping unit should be fitted with a sensitive beam mounted safety cut-out switch. This type of switch will stop any type of prime mover if its beam is subjected to an impact load. In the case of a unit powered with an engine, it stops the engine by grounding out the magneto and it stops an electric motor by opening the magnetic starter. The engine can be given additional protection from damage due to high temperature and low oil pressure by additional safety cut-out switches. The usual magnetic starter will protect an electric motor from overload and low voltage.

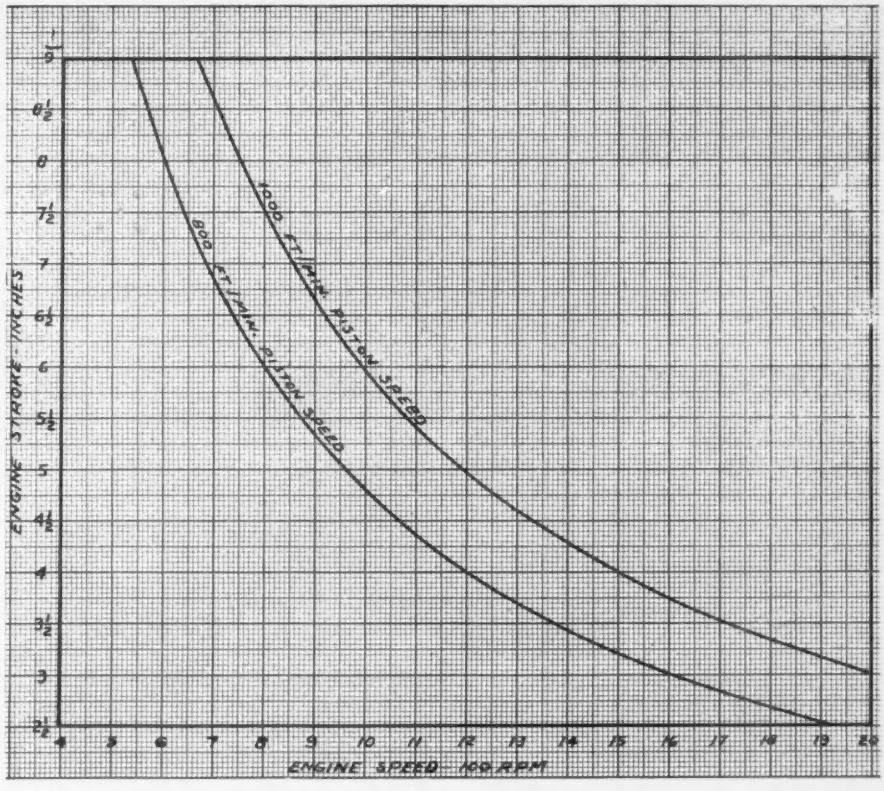


FIGURE 12

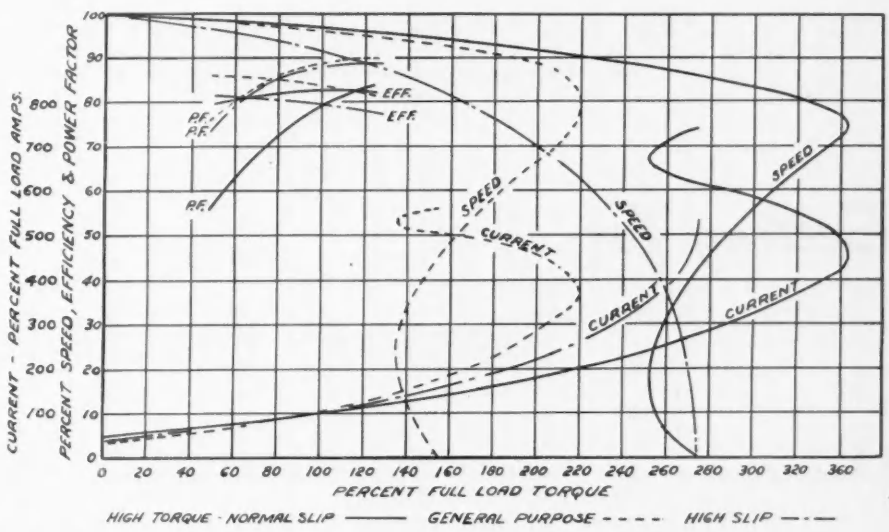


FIGURE 13

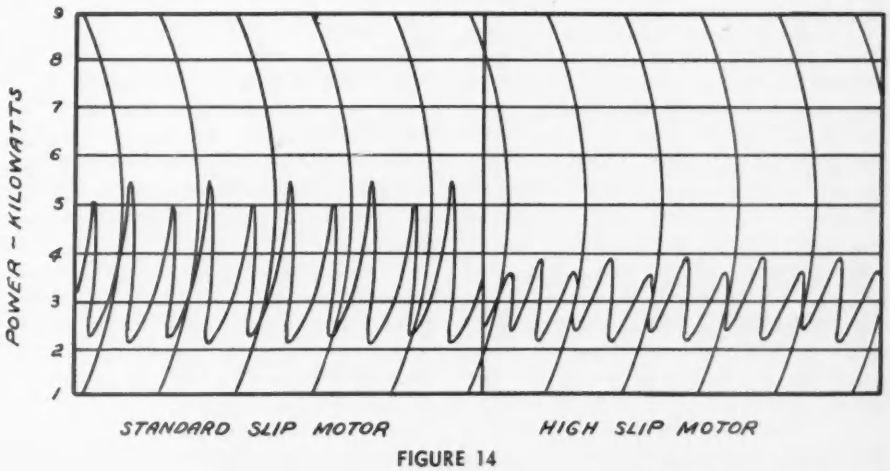


FIGURE 14

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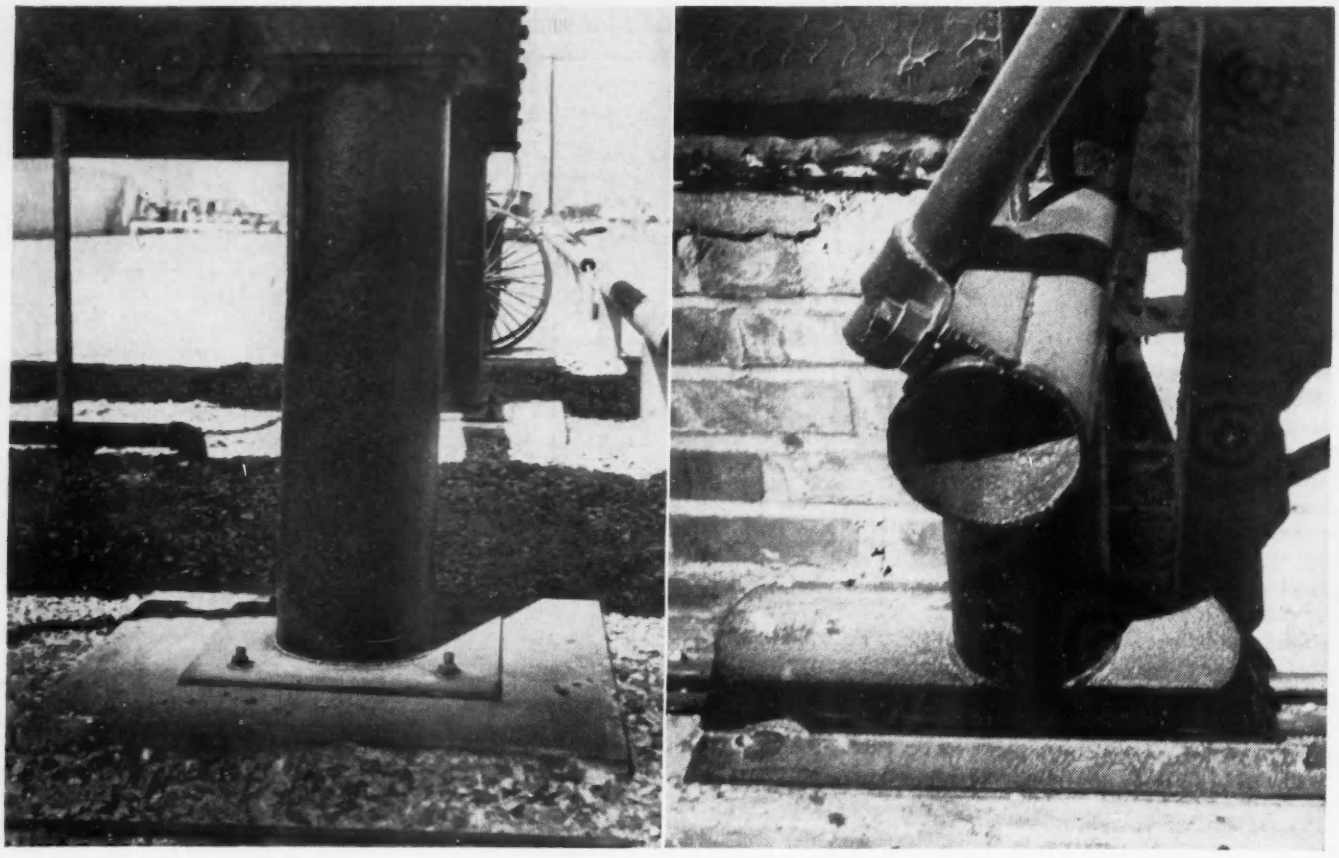
[1]Almen, J. O. "Fatigue of Metals as Influenced by Design and Internal Stresses," 27th Nat'l Metals Congress, Cleveland, Ohio.

[2]Mills, Kenneth N. "High Slip Electric Motors Used for Oil Well Pumping," Petr. Engr., Nov. 1944.



LEFT: Smokebox end of boilers, showing smooth pipe support having shaped saddle at the top, and flat plate for footing which is bolted to concrete pier. RIGHT: Boiler support resting on "I" beam footing set outside the combustion chamber to eliminate damage by firebox temperature. Lower end of stack support is secured with saddle so stack can be adjusted to a vertical position.

Setting for Treating Plant Boiler

OILFIELD type boilers installed with a recently constructed tank battery and oil treating unit are set with the anticipation of permanency.

Design of the supports of these boilers takes into consideration that the weight of the units is carried by specially built standards and brackets. Supports for the smoke box end are designed to hold this end of the boilers rigidly in position. Instead of trimming the end of a random piece of pipe to conform to the contour of the boiler at this point, rectangular sheets of heavy boiler plate are rolled so that pin-point contact is eliminated. The saddles in turn are welded to a large diameter pipe nipple with a continuous bead to obtain maximum strength and to reduce the stress concentration of tack-welds. The base of the pipe nipple is welded to a large, flat, rectangular sheet of similar metal and, likewise, attached with a full circumferential weld. Holes drilled through the smoke box sheet provide means of bolting the saddle directly to the shell to prevent anticipated creep and movement of the boiler. As a foundation for the standard, or pipe support, there is a large, substantial concrete pier with the upper surface practically flush with the graveled area. Foundation bolts set into the concrete pier pass through matching holes in the flat plate footing of the supporting pipe nipple.

To carry the firebox end of the boiler, pedestals are set on either side of the combustion chamber with footing made of a section of structural steel I beams. A cross member of 4-inch pipe is placed so that the mudring of the boiler is the only contact at this point. The footing sections are trimmed to improve their appearance, and installed parallel to the boiler to reduce the probability of any movement. A concrete slab, or large pier, is poured large enough to carry the bricked-in combustion chamber and the boiler support footing. Dowel pins of 1-inch steel are set in the concrete to match holes bored in the base of the foot pieces to prevent movement in any direction.

To support the stack of the boiler, braces extend from the clamp band around the stack to the ends of the firebox supporting member. At this point, adjustments are provided by welding a section of angle iron to the cross member with one of the flat surfaces approximately in line with the direction of the stack brace. Bolts on each side of the brace secure shaped saddles which clamp tightly against the brace to maintain the desired position of the stack.

The Mechanism of *Air-Gas Drive*

Part 2—Conclusion

By D. E. MENZIE and R. F. NIELSEN
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FIGURE 14 is a graph of the brine saturation in the core at the time of air break-through at the producing end of the core versus the pressure used for the drive. Although the experimental values are not altogether regular, the general trend is toward a reduced saturation at break-through for the higher pressure. The higher pressure may tend toward a higher saturation gradient behind the flood front due to overcoming the capillary retention to a greater degree. The circled points are actually observed break-through points. They are the points at which the first gas bubbles are noticeable at the end of the core. The other values are obtained from the gas volume data by extrapolating back.

Figure 15 is a curve of brine recovery rates against time of the drive in hours. The 4.68 pounds per square inch curve shows a very low but steady rate of brine recovery up to the time when the final brine bank is being forced from the end of the core. At this time the recovery rate reaches a peak. The air break-through at the producing end of the core will immediately follow this peak rate. Thus, from the curve for the low pressure run the air break-through would be approximately 0.4 hour. This is very close to the actual observed time of break-through of 0.418 hour. Obviously, if the time of break-through can be observed, and the rate of brine recovery measured, the saturation at break-through can be calculated. The saturation at break-through as determined by this method of average rate (See Figure 15) is in very close agreement with the saturation measured electrically and volumetrically at the break-through point. The high drive pressure curve of this figure is very similar to the low pressure curve except that the time of break-through is greatly reduced. This, coupled with the increased rate of flow, results in the saturation being reduced to approximately the same value.

Off-hand, one might expect that as the air front travels through the core an increased rate of brine recovery would be realized from the core. As the air front moves along the core relatively small volumes of air are flowing, and there would be little pressure drop in the gas phase, whereas the liquid plug ahead of the front is getting smaller as the front progresses. From this one would expect an increasing rate of brine recovery prior to break-through. The curves show a fairly constant rate of brine recovery, with a noticeable increase just before break-through. Therefore, it appears that an increasing pressure differential must be found in the gas phase behind the front as the drive progresses. This increasing differential reduces the effective differential across the liquid phase which can expel the brine. The decreasing pressure drop apparently compensates for the decreasing distance from the flood front to the producing end of the core, so as to maintain an approximately constant rate of production. The very low relative permeability to gas just behind the front must also compensate for the low viscosity of the gas to cause the pressure drop in this region. It seems, however, that most of the pressure drop in the two-phase region must be fairly near the flood front, since according to Figure 5, the sections near the upstream end of the core show a noticeable increase in production after air break-through. This increase is less noticeable in the sections near the producing end.

In an attempt to study further the mechanism of air drive prior to break-through a calculation based upon the fractional flow formula and as proposed by Babson[14] has been performed. The original data are taken from Figures 5, 11, and 20. The formula is

$$F_g = \frac{1 + \frac{K_w}{\mu_w Q_t}\left(\frac{\partial P_c}{\partial X} - g\,\Delta\rho \sin \alpha\right)}{1 + \frac{K_w \mu_g}{K_g \mu_w}}$$

where

F_g = the fraction of water in the flowing stream passing any point in the sand.

K_g and K_w = effective permeabilities to oil and water.

μ_g and μ_w = oil and water viscosities, cps.

Q_t = total fluid rate per unit cross-sectional area, cc./sec./sq.cm.

$\frac{\partial P_c}{\partial X}$ = the capillary pressure gradient in the X direction, atmos./cms.

g = conversion factor, atms./cm. H_2O.

$\Delta\rho$ = the difference in densities of fluid flowing, gms./cc.

α = the angle made by the direction X with the horizontal.

The gravity term is zero for these experiments. The error introduced by neglecting the term $\left(\frac{\partial P_c}{\partial X}\right)$ is very small, as the following calculation shows. From a cross plot of a graph of capillary pressure versus saturation and saturation at break-through versus distance it was possible to obtain a curve of capillary pressure at break-through versus distance from input end of the core. This curve is shown in Figure 16 for the 4.68 pounds per square inch run. The $\left(\frac{\partial P_c}{\partial X}\right)$ term calculated from this curve affected the F_g term by approximately one percent. This means the $\left(\frac{\partial P_c}{\partial X}\right)$ term can be neglected up to the time of break-through and still not appreciably affect the calculation of the fraction of gas flowing. The complete calculation of the average brine saturation behind the flood front is shown on Figure 17. The average saturation of 89 percent brine as calculated compares favorably with the measured saturation 89 percent by resistivity.

In a number of calculations previously performed the relative permeability to air and brine and the K_g/K_w ratio are required as a function of saturation. The following general procedure was used to determine the curves. A certain given point in the core was selected as a reference point. The brine saturation at

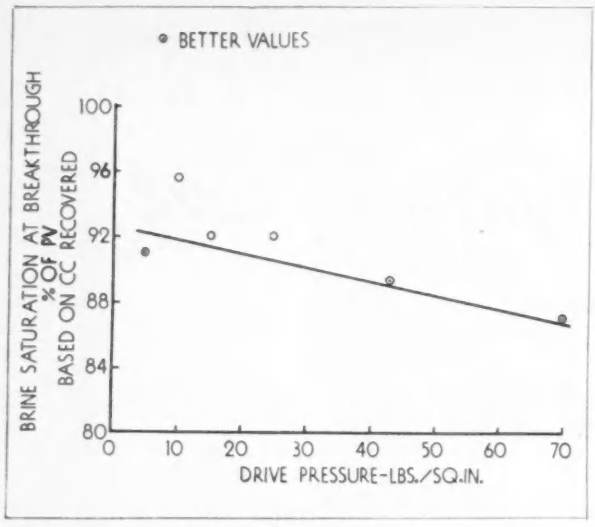

FIGURE 14. Saturation at break through v. drive pressure.

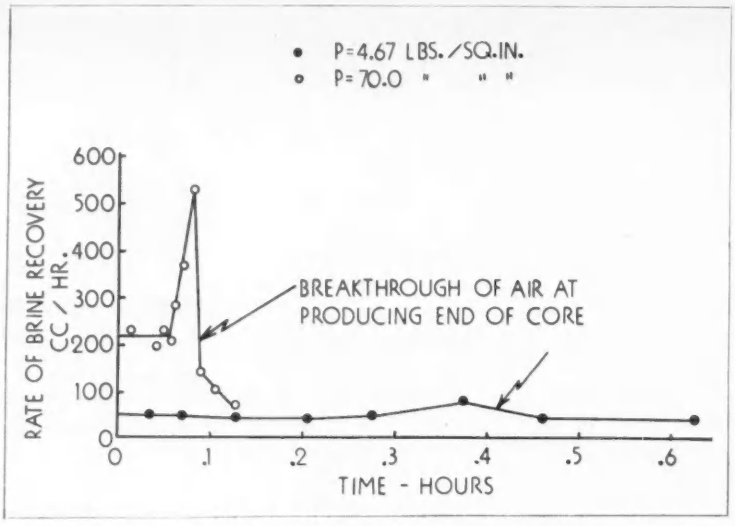

FIGURE 15. Rate of recovery v. time; typical early history of the runs.

this point and in all sections upstream was known by resistivity at any given time during a run. By calculating the change in saturation of all the upstream sections as a function of time, the rate of flow of liquid passing through the core at that point was determined. Figure 18 is a graph showing the change in saturation with time for the 4.68 pounds per square inch run. Figure 19 is a similar curve for the air volumes in which the cumulative air volumes are plotted against time. The rate of flow of air through the core was thus obtained. From the rates of flow of air and brine, the relative permeability ratio, K_g/K_w, was calculated. This ratio is shown as a function of brine saturation on Figure 20. The approximately straight line relationship on semi-log paper is in agreement with the work of other investigators.[11, 12]

Figure 21 shows the K_g curve which has been determined experimentally as previously described. By back-flowing the core at the time the air rate is determined, the end effect can be more or less eliminated and thus a measure of the flow of air obtained with a fairly uniform saturation throughout the core. If the K_g/K_w curve is known and the K_g curve has been measured the K_w curve can readily be determined.

The various types of data have so far been discussed more or less separately. It remains to show their correlation and to interpret the facts in the light of this correlation. The curves of final residual brine saturation distribution for the various pressures appear to show the same saturation for any section of the core (real or extrapolated) not affected by the "end effect." This indicates that the final residual brine saturation during an air drive is not a function of the pressure gradient. This is further strengthened by the fact that the capillary pressure curve shows an irreducible minimum saturation of this core which is approximately the same saturation as was found for the sections of the core not affected by the end effect. The magnitude of the end effect after the air drives is shown by some of the curves discussed. After the low input pressure drives, the end effect was much larger and extended over more of the core. This is because the input pressure is not as great as the capillary pressure for the minimum saturation which it is possible to obtain.

In the high pressure runs where the input pressure is well up on the vertical section of the capillary pressure curve, the input sections of the core are nearly reduced to the minimum saturation. From this line of reasoning we can conclude that the final residual brine saturation during an air drive is a function of the absolute pressure of the section and its relative position on the capillary pressure curve. For instance, consider a series of cores identical in every respect except length. These are subjected to air drives of the type made in this study, the upstream pressure being always the same. The gradient may be made as

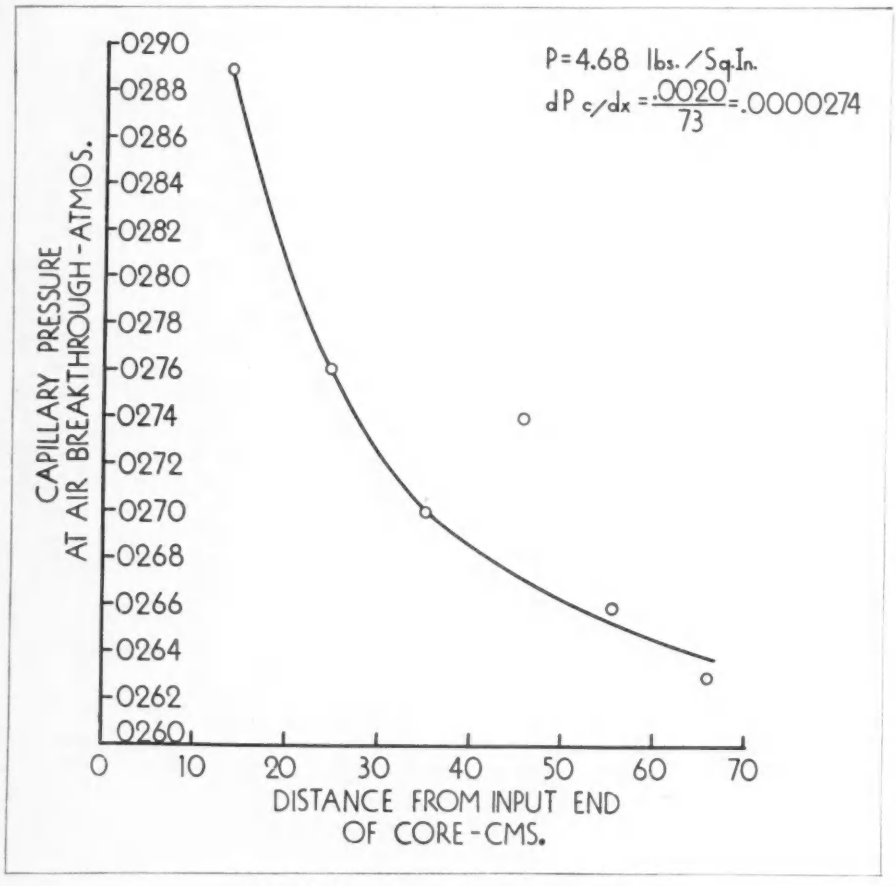

FIGURE 16. Capillary pressure v. distance.

small as desired by having a sufficiently long core. From the capillary pressure curve, any pressure above 100 lbs. is practically on the vertical part of the curve, corresponding to 46 percent liquid saturation. If, then, the upstream pressure is 200 pounds, the pressure will be more than 100 pounds over more than one-half the core. Therefore the ultimate saturation reached in the upstream half will be 46 percent, even though, if the core is extremely long, the pressure gradient for this section may be extremely small. It would be of interest to see actual data on cores or packed tubes in which length and pressure are the only variables.

Errors

The determination of brine saturations by resistivity appears to be accurate to within 1 percent. The saturations by weight are accurate to within a fraction of 1 percent and the saturations determined by the volume of liquid collected are considered to be correct to of 1 percent and the saturations de-air prior to entering the core the amount of evaporation was held to a minimum. The produced air volumes were measured to within 1 percent and errors were reduced by measuring the air over water in a wet test meter. The temperature during the runs which could affect both gas volumes and resistivity measurements if allowed to vary was accurately controlled at a constant temperature (± 0.5 degrees Centigrade). The difference of the capillary pressure data appears to be of the order of 3 percent liquid saturation when comparing data from a plug core and data from the long consolidated core. The pressure of the input air was regulated to less than 1 percent variation.

An indication of the magnitude of the over-all errors of the data collected during this series of air drives can be obtained by observing the degree of reproductiveness of the two runs made at 10 pounds per square inch pressure.

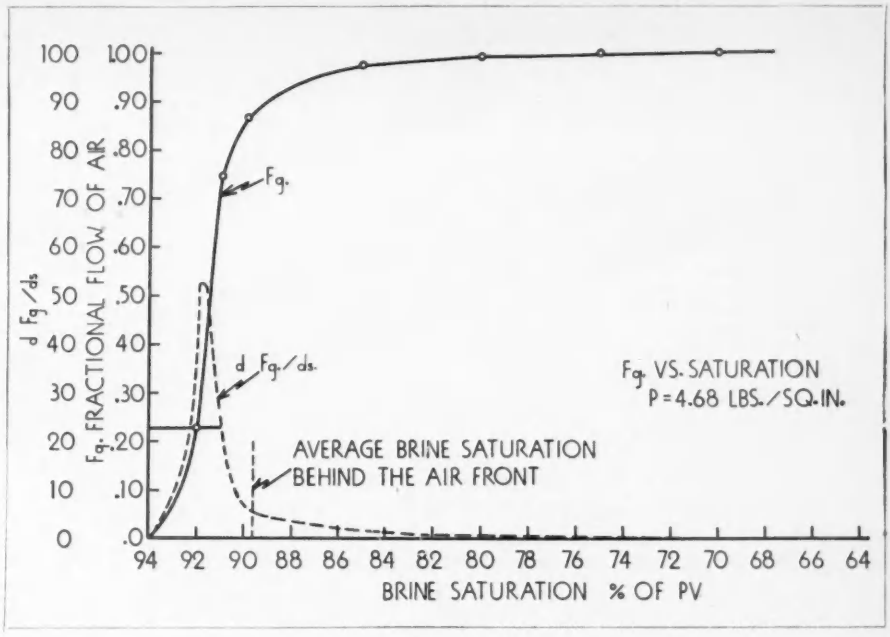

FIGURE 17

The points for the original run and the check run fall very nearly on a common line. In general the difference in saturation appears to be approximately 1 percent at any given time during the drive.

Summary

A study was made of the air drive mechanism in a consolidated sandstone 100 percent saturated with brine for eight different driving pressures. The saturations were measured by resistivity on separate sections of the core. Saturation-time curves were obtained showing the various stages in the production from each section. Volumetric measurements were made of gas and liquid production throughout the runs. It is apparent that any individual section of the core reacts in three separate stages to the air drive imposed upon it. The first stage is prior to the passing of the flood front through the section; the second stage occurs after the flood front has passed the section but prior to the air break-through at the producing end of the core; and the third stage is after break-through of air and after air flow is established. Capillary pressure-saturation curves were obtained for the long core and for a plug drilled from one end of the long core. From the data obtained, calculations were made of saturation distributions, relative permeabilities to the two phases, theoretical saturation at break-through, and extent of end effect.

Conclusions derived from the experiments and calculations:

1. A fairly constant rate of brine recovery prior to break-through was observed for each driving pressure with some increase in rate immediately before break-through.
2. A greater brine production was indicated before air break-through for the higher pressure gradients, although the variations were small.
3. Calculated values of saturation at break-through are shown to agree with the observed saturations by resistivity.
4. The error introduced by neglecting the term $\left(\frac{\partial P_c}{\partial X}\right)$ in the Fractional Flow Equation is shown to be very small for the time up to air break-through.
5. A method of calculating relative permeabilities to the liquid phase is presented based on cumulative reductions in saturations upstream from a point in the core.
6. The calculated end effect based on capillary pressure phenomena showed an agreement with the measured end effect after an air drive within the limits of experimental error of the data involved.
7. The curves of final residual brine saturation distribution for the vari-

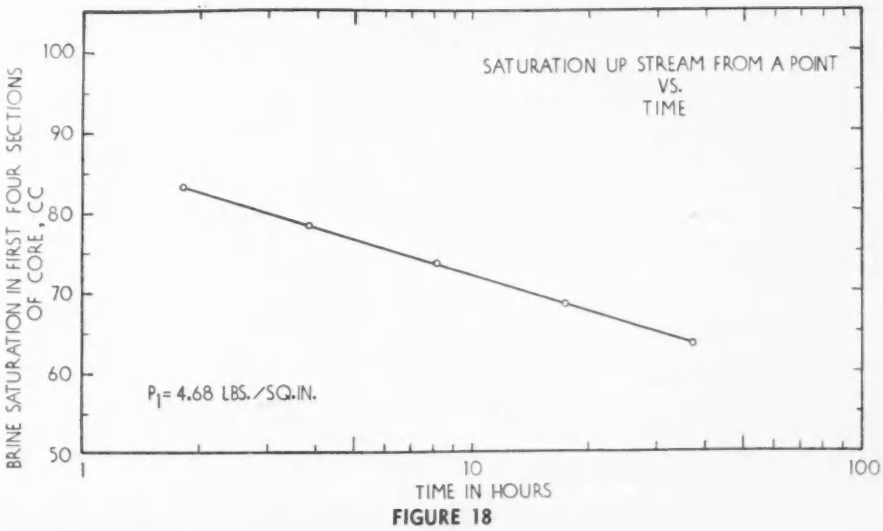

FIGURE 18

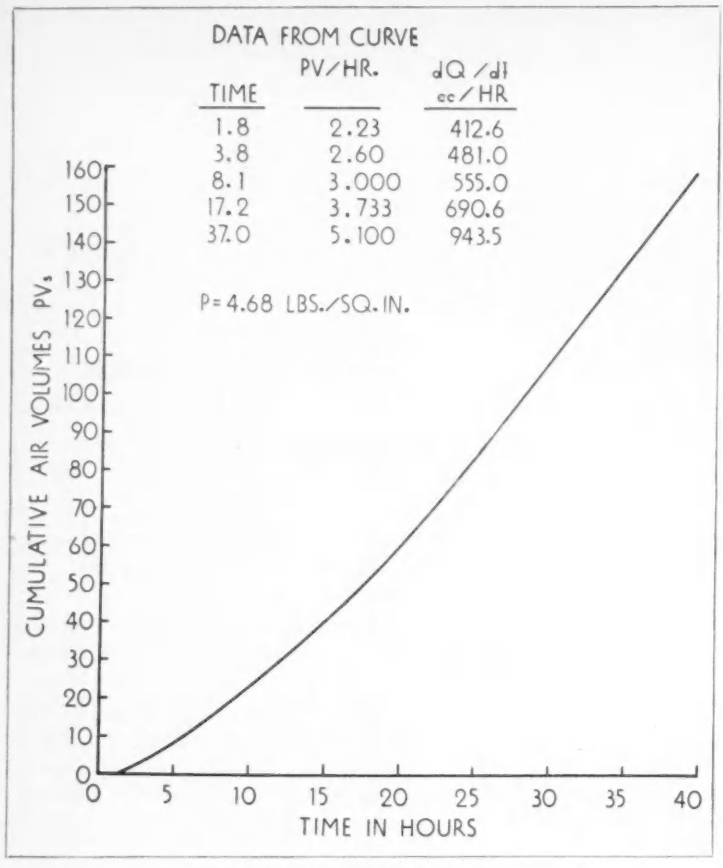

FIGURE 19. Air volumes v. time.

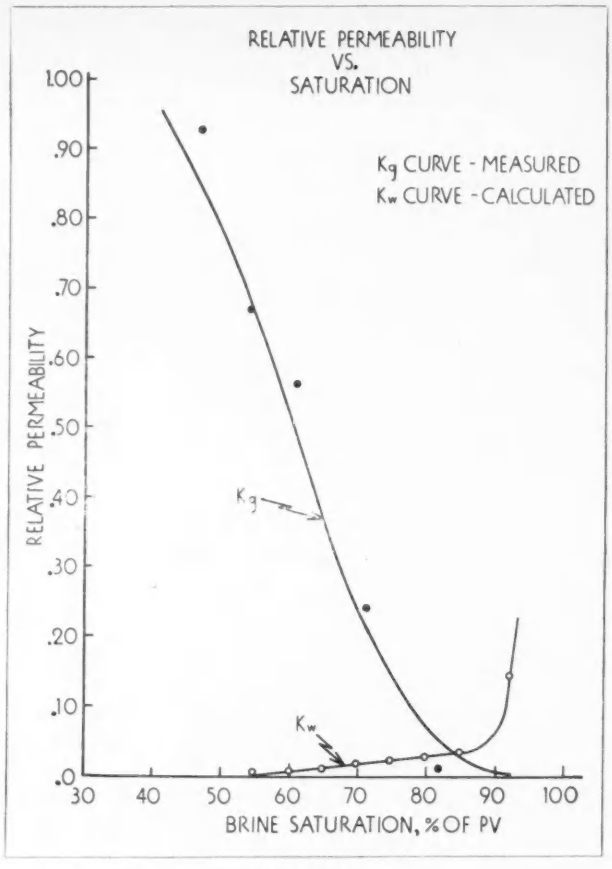

FIGURE 21

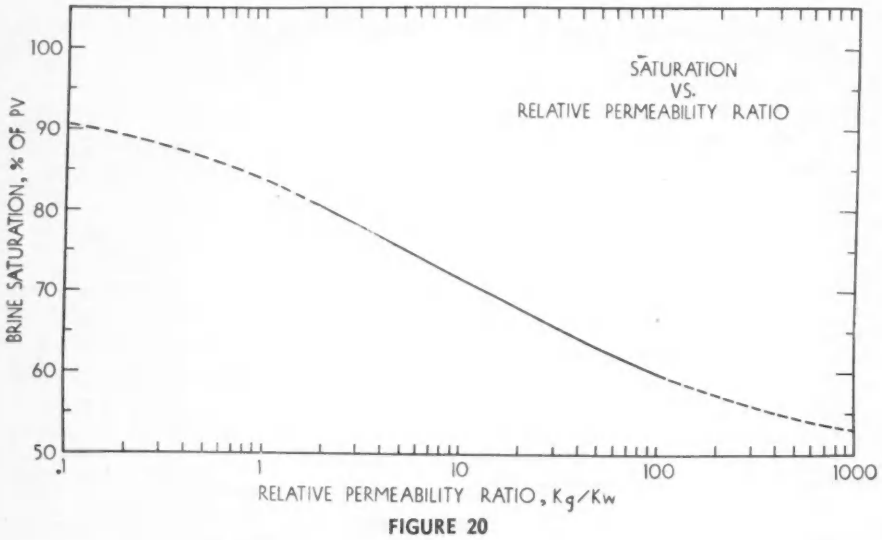

FIGURE 20

ous pressures appear to show the same residual saturation for any section of the core (real or extrapolated) not affected by the "end effect."

8. The capillary pressure curve shows an irreducible minimum saturation which is approximately the same saturation as was found for the sections of the core not affected by the end effect.
9. The pressure gradient during an air drive on a 100 percent saturated core does not affect the ultimate saturation provided the end effect is eliminated.
10. The final residual brine saturation at any point during an air drive is a function of the pressure during the air drive at that point relative to the pressure at the producing end. This residual saturation corresponds to the value given on the capillary pressure curve at the same pressure.

ACKNOWLEDGMENT

The authors wish to thank the members of the staff of the Division of Petroleum and Natural Gas Engineering for their interest and help and the members of the Pennsylvania Grade Crude Oil Association for their support of this work.

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Phosphorus	0.04 max
Sulphur	0.04 max
Silicon	0.20 to 0.35
Nickel	1.65 to 2.00
Molybdenum	0.20 to 0.30

MECHANICAL PROPERTIES

	Average	Minimum
Yield Point	70,000 psi	65,000 psi
Tensile Strength	85,000 psi	80,000 psi
Elongation in 2 in.	38 pct	35 pct
Reduction of Area	65 pct	60 pct
Brinell Hardness Number	170	159
Izod Impact	—	90 ft-lb

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Minimizing *Red Water* Troubles

By L. C. CASE
Gulf Oil Corporation

THE occurrence of objectionable iron in water poses serious problems in water flooding and/or salt water disposal projects because of possible clogging of producing formations, and aquifers and engineers long have sought economical and efficient methods to overcome this problem. Unfortunately, this condition is fairly common and many literature references give considerable space to a description of the problem and its possible solution. Water so burdened with iron is commonly known as "red water" and is especially objectionable in many areas in the southwest where water for secondary recovery and for drinking purposes is deficient both in quantity and in quality.

The following detailed account of a successful solution to this problem is based on data obtained on the domestic water supply at a pipe line station. It is presented for the benefit of oil operators who have experienced difficulties in treating "red water" and shows that the principles can be applied successfully to water clarification generally.

Dissolved iron in greater amount than about 0.3 milligram per liter gives a definitely unsatisfactory appearance to domestic water. Accumulations of the iron which deposit in pipes are sometimes stirred up by sudden or vigorous flow so that the water is quite definitely red in color. The cause of this condition is often erroneously attributed to corrosion of water pipes, since iron may not be visible in the water as it is pumped from a water well. Actually, the occurrence of appreciable iron, due to the corrosion of well equipment, surface lines or tank interiors, in fresh water supplies is quite rare. On the other hand, water wells commonly produce a very clear water which, upon losing carbon dioxide and coming into contact with air, may become quite turbid in a few hours due to precipitated ferric hydroxide.

In common with many other problems due to water, the problem of "red water" has a number of solutions, none of which may seem practical when applied to certain field conditions. Processes involving chemical softening, aeration, chlorination and base exchange will remove dissolved iron. Precipitation of iron may be prevented by a method termed "sequestration," using various polyphosphates. This is a practical method for potable water systems only where low amounts of iron are involved. Chemical softening requires filtration and the use of large settling basins to effect complete clarification. Chemical treatment of any kind is generally objectionable at small field installations because of the constant and expert attention required. For this reason, it often is desirable to drill one or more additional water wells in a search for aquifers giving iron-free water, rather than attempt a continuous water treatment. If this substitute method fails, then the situation becomes one of selecting the iron-removal method best suited to existing conditions. Preferably, the method should not require much additional construction; it should be simple and economical in operation and its details should be easily understood by nontechnical attendants. A solution having the latter qualifications has been applied to a particularly troublesome problem where the iron content of the water supply was found to increase gradually over a period of years. The process now being used has proved entirely satisfactory over a two-year period. The low installation and maintenance costs are somewhat remarkable, as are the results being achieved. The following description will furnish sufficient details to allow duplication of the process whereever iron or similar turbidity removal may be desirable. The method can be applied to water clarification in considerable volume as in operations involving water flooding and/or salt water disposal.

THE AUTHOR discusses the phenomenon of iron contamination of water, and describes some methods worked out for the batch treatment of such iron-bearing water for removal of the contaminant as floc, without affecting either pitable or water-flooding usefulness of the fluid so treated.

Case History of a Bad Water Supply

The first appearance of small quantities of iron in the water at this pipeline station was believed due to corrosion of "line pipe" which carried water from the supply tank to the cottages. Observations on a test section of the line disproved this assumption. Installation of galvanized tubing and rods in the water well did not reduce appreciably the iron content of the water. Shortly thereafter, chemical tests during continued pumping established the fact that the well water contained dissolved iron. Also, the iron content was shown to increase during prolonged pumping periods and following seasonal drought. The latter phenomenon was unexpected since the well depth of 240 feet was thought to be far below the level usually influenced by seasonal changes. Maximum iron content of the water at this time did not exceed 18 mgm per liter. The process of "sequestration" was therefore indicated rather than iron precipitation and removal. This method involves the continuous addition of polyphosphate, in amounts of one to four times the iron content, depending upon the degree of clarification desired. When used properly the complex phosphate holds the iron in solution so that it does not precipitate as red stain. Continued boiling of water so treated will nevertheless cause reversion of the polyphosphate, to the orthophosphate form, with eventual precipitation of the iron. For the latter reason, the polyphosphate requirement is relatively greater for a domestic water supply than, for example, a water used for water flooding of an oil sand.

A lubricator was set at the well-head so that the polyphosphate solution was added to the well water on the way to the supply tank. In this manner, one-

third of a pound of the phosphate was intimately mingled with each 1000 gallons of water. This quantity may be otherwise stated as 40 mgm per liter in the produced water, which was more than double the maximum iron content. This treatment resulted in general satisfaction with the water supply for 2½ years, when complaints concerning the water again became persistent. Investigation revealed that the well water had not increased in hardness or salt content. However, the dissolved iron ranged, at different periods of sampling, from 16 to 45 mgm per liter. In further complication of difficulties with this water supply, large growths of iron-consuming bacteria appeared, more or less in ratio to the increase in iron content. These micro-organisms were noted as slimy, stringy masses, giving a very objectionable appearance to the water. In addition, the presence of the iron bacteria imparted unmistakably bad odor and taste quite in keeping with the appearance. Intermittent heavy dosage with chlorine produced only temporary relief from the slime and odor.

All possibilities of changing the source of water supply were considered and found impractical. Consequently, the problem remained one of selecting the method for iron removal best adapted to existing plant equipment and personnel.

Iron Removal by Aeration

At the outset in these considerations the aeration method was regarded with favor because compressed air was already available. Water softening by chemical treatment would, of course, also effect satisfactory iron removal. The use of chemicals, however, has the disadvantages of requiring close supervision, chemical proportioners and large storage capacity to provide for detention time and coagulation. In general, iron removal by any means is retarded by the presence of carbon dioxide, organic matter and manganese. Of these interfering substances, the water in question was found to contain only carbon dioxide. Aeration then, should force the iron out of solution by CO_2 removal and oxidation essentially in accordance with the following reaction.

$$4\,Fe(HCO_3)_2 + O_2 + H_2O = 4\,Fe(OH)_3 + 8\,CO_2$$

The conversion to insoluble ferric hydrate is hastened by the presence of hydroxyl ions. Thus, precipitation and coagulation are facilitated by the addition of caustic, lime or sodium aluminate. The step of aeration required only the erection of a small steel tank, equipped with air diffusers. If the efficiency of the aerator could be such as to provide rather complete conversion of the iron to ferric hydrate, which in turn acts as a coagulant, then complete clarification of the water entirely without the use of chemicals seemed a possible objective. The iron compounds being dealt with are quite unstable and it is therefore impossible to determine from samples sent to the laboratory the exact degree of aeration and coagulation required in practice. It was finally decided to install an aerator and a pressure filter which could be cleaned conveniently by backwashing from the elevated supply tank already at the plant. Necessary aeration time was determined at the plant by "trial and error" method. An initial 30-minute aeration period was increased by 30-minute increments until the optimum point of coagulation was reached. Samples of the treated water were observed to remain free of turbidity following the aeration, minimum coagulant dosage and filtration.

Description of Plant Equipment

Layout of the equipment is illustrated in Figure 1. It will be noted that the 100-barrel steel tank and small pressure filter plus a certain amount of additional piping and valves, constitute the only changes made in the original water system. The aerator tank was equipped with four 4 x 24-inch ceramic tubes, spaced near bottom to serve as air diffusers. Available air pressure from the station was 80 pounds per square inch. This was reduced to five psi at the tank where it is sufficient to overcome the water head, at the same time protecting the ceramic tubes from breakage. The tank is vented to allow escape of air. Construction details of the filter are shown in Figure 2. Simplicity of this design contributes to initial low installation cost as well as trouble-free operation. The filter has required no maintenance over a two-year period. Recent inspection showed also that original gravel and sand filter bed was in perfect condition.

Operation of the Equipment

The "batch process" method is used to allow longer contact time in the aerator. Water is pumped from the well directly to the aerator tank. Necessary aeration time was determined by the simple expedient of turbidity observations on filtered samples at 30-minute intervals. It was found that two hours' aeration effected complete precipitation of the iron. However, the iron floc was too fine to be removed completely by the filter. The addition of eight ounces of liquid sodium aluminate at the end of the aeration period, with a few minutes' additional agitation by air, was found to coagulate the floc satisfactorily. This procedure is used in routine operation. Following aeration and coagulation, the water is pumped through the filter to the elevated supply tank. Pump pressure averages about 20 psi when the filter is freshly cleaned. When the pump pressure reaches about 80 psi the filter is backwashed with clear water from the supply tank. The vigorous backwash stream lifts the filter bed and removes the accumulated red ferric hydrate. When the backwash current is shut off, filter bed material assumes its proper gradation of largest particles on bottom and progressively finer upward, in accordance with Stoke's equation for settling particles.

Data on Treating Efficiency

Chemical analyses on the well water have shown changes of considerable magnitude over relatively short periods, indicating two or more separate zones

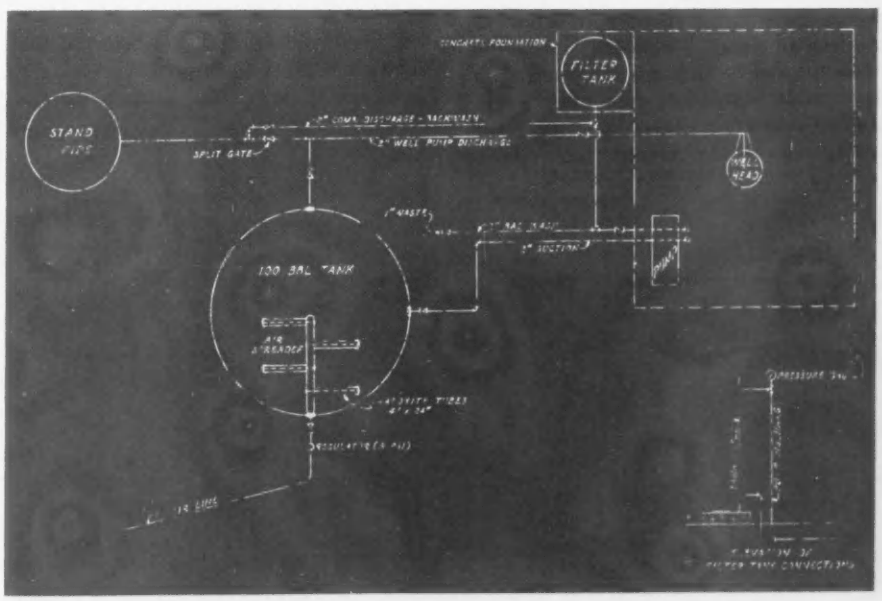

FIGURE 1. Water system after revision for iron removal.

contributory to the water supply. Recent analytical data are shown in Table 1.

It will be noted that hardness and dissolved solids of the raw well water never became objectionable, even when the iron content reached the amazing figure of 45 mgm. per liter. The high carbon dioxide content of the well water has particular significance to the iron content and slightly corrosive nature of the water. Where the calculated pH of calcium carbonate saturation, or pH_s, is above actual pH, the water is undersaturated with corrosive tendency. Similarly, where pH_s is below actual pH the water is supersaturated, with tendency to scale formation. Thus, the raw well water has corrosive tendency at all temperatures below 190° F., while the aerated water is shown to range from near equilibrium at lowest seasonal tank temperatures to slightly scale-forming at highest seasonal temperatures.

The removal of CO_2 in the aeration process is directly responsible for this change of the water from "aggressive" to slightly scale-forming condition. This change is desirable from the standpoint of possible corrosion on the inside of the water supply tank and steel lines. The vigorous aeration which the water receives would logically be expected to produce a high degree of oxygen saturation. The possibility of corrosion in the tank and lines, due to the dissolved oxygen, may not be evaluated by the analytical data or stability calculations given in Table 1. Determination of dissolved oxygen in the water and its effect on corrosion are not easily or precisely found by direct chemical testing and calculation. The method of exposing steel coupons in the tank and lines would have merit. Also, the iron content of water, which has stood in the system for a considerable period, should constitute a reliable index. It is shown that the iron content is reduced to a trace in the treated water. Therefore, water from various parts of the system should not show more than trace amounts if corrosion is negligible. Tests on water from dead ends of the system have shown very little pickup of iron and, for this reason, future troubles due to corrosion from any cause are not anticipated.

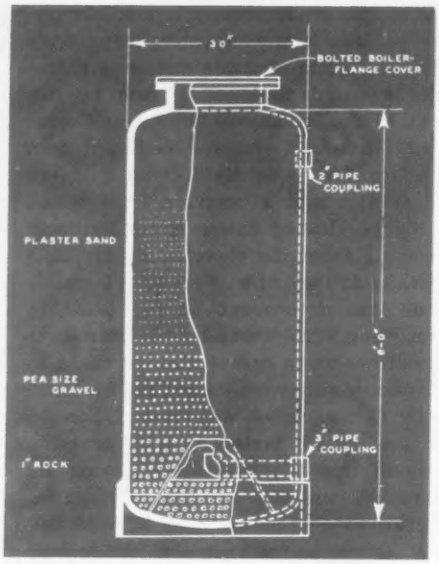

FIGURE 2. Detail of pressure filter.

Conclusions

It has been demonstrated that aeration may be used as a practical method for iron removal from water. Initial costs of equipment are low since coagulation basins are not necessary. Operation costs are quite low due to minimum use of chemical. In addition to accomplishing effective iron removal, the aeration method is shown to inhibit anerobic bacteria of the iron-consuming type. Other anerobes such as sulphate-reducing and pathogenic bacteria would also be inhibited or destroyed by the addition of oxygen. Finally, it is strongly indicated that oxygen, added to fresh water during aeration, does not increase materially the rate of corrosion attack on uncoated steel tanks and water lines. In the system herein described, it is believed that the switch from high carbon dioxide to high oxygen content has actually lowered the corrosion rate in the elevated storage tank.

FIGURE 3. View of pump house, filter and aerator tank. Camp cottages are in background.

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TABLE 1

Water Analyses

		Raw Well Water	Treated Water—from Supply Tank
mgm. per liter	Na	27	62
	Ca	49	58
	Mg	1	1
	SO_4	5	4
	Cl	17	57
	HCO_3	190	243
Total Solids by Conductivity, mgm./l.		130	225
Total Iron, mgm./l.		45	0.1
Free Co_2, mgm./l.		27	6
Total Hardness as $CaCO_3$, grns./gal.		7.4	8.7
pH Value		6.8	7.7
Langelier Index, (pH_s or pH of calcium carbonate saturation)			
	50° F.	8.0	7.6
	100° F.	7.5	7.1
	150° F.	7.1	6.7

Gas Lift
Principles and Practice
Part 1

By C. D. FLETCHER
Sales Manager, Merla Tool Corporation

IN THIS SERIES, the author discusses modern gas lift as a production aide, describing the various types of installations, settings, results obtainable, and mode of operation. Part 1 covers the introductory portion of the series, and will be followed by 3 parts which will take up gas lift systems and describe the equipment by which they function.

IN GAS lift operations, it is very important that the basic principles of gas lift be understood and correctly applied to meet the individual well requirements. Selection of the correct type gas lift installation as well as selection of the correct type gas lift equipment is of major importance if satisfactory operation is to be obtained. There are so many varied well conditions to cover with gas lift operations that various types of installations and equipment are necessary to meet the requirements.

The single gas lift valve to meet all possible well conditions has not yet been designed and it is doubtful whether a single type valve will ever be developed that will do so. Each type valve and each type installation is designed to cover a certain range of specific well conditions. The development of valve designs and installation practices has permitted their relegation to distinct categories for their most efficient operation.

Development of the equipment and practices through the jet collar, automatic differential, continuous flow and intermitting stages has placed the equipment and installations in categories bounded by their efficiencies under particular well conditions. With this advancing design of equipment and practices, it is possible to match the equipment and installations with the well conditions and secure the maximum efficiency in gas lifting operations.

The first step in the selection of gas lift equipment and the type installation to use is the determination of the well conditions under which it will be operated.

The productive capacity of the well in both oil and water, present and future, should be known or estimated. Bottom-hole pressure, fluid gradient and productivity index are important factors in determining the number of valves to be used and their position in the well. The static fluid level, a governing factor in positioning the top valve, can be obtained by actual test or from bottom-hole pressure and fluid gradient data. In computing valve spacings, the fluid gradient is an important factor. The working level, important in positioning the bottom valve, is obtainable from bottom-hole pressure and productivity index data together with the desired production of the well.

When these factors are unknown by the operator, they must be estimated and generally result in designing an installation to meet maximum conditions. When this occurs, many valves are usually unnecessarily run and consequently never operated. Even the wrong type valve might be installed.

The next step is selecting the operating gas pressure. This, in some cases, will not be the pressure presently available as the pressure selected must be available for the number of years it is expected to operate the equipment. If this is not considered, it might become necessary to pull and reset the equipment due to a change in available pressure.

If the gas supply is obtained from a gas reservoir under pressure, sufficient allowance should be made for pressure decline so that the design pressure will be available as long as it is needed. If the gas is obtained by compression, the pressure selected will depend upon the depth of the wells and the economics of compression.

The required gas volume should be calculated and its availability assured for the operations. Generally speaking, the pressure and volume are dependent upon depth of operation, viscosity and quantity of fluid to be lifted, and the type of gas lift operation selected.

After the well characteristics have been analyzed and the operating pressure determined, the most suitable type of valve must be selected. Design and operating characteristics of the equipment should be clearly understood. Some of the main factors to understand, particularly in intermitting operations, are effects of hydrostatic pressure and temperature on the operating characteristics of the equipment. The manner of compensating for weight of gas column in the casing annulus and size of valve inlet port for volume passage are also important factors. It is best that the services of a competent gas lift engineer be utilized in analyzing these factors to be sure they are reasonably accounted for and clearly understood.

There are numerous sources of energy loss contributing to the efficiencies of gas lift operations. It is impossible to calculate mathematically the energy losses from these sources because many of the controlling factors cannot be evaluated. Any conception of their relative effect upon the efficiency of a given installation can be obtained only by experience.

In evaluating true efficiencies, the amount of energy contained in gas from the natural production of the well should be considered as well as energy in surface injected gas.

Many factors governing gas lift operating efficiencies, such as slippage, friction and physical properties of fluid produced, cannot be controlled. Their effect, therefore, must be counteracted by controllable factors.

Factors—Uncontrollable

1. Slippage losses in the lower part of the eductor tube caused by the fluid dropping back through the ascending gases. This loss is dependent upon the physical properties of the oil, water and gas being produced and starting velocity of the fluid.
2. Friction losses in the upper part of the eductor tube resulting from friction between the flowing fluid and eductor walls. This loss is dependent upon specific gravity and viscosity of the fluid, diameter of the eductor tube and maximum fluid velocity.

Since the physical properties of the

oil and gas produced and specific gravity and viscosity of fluid cannot be controlled, their effect upon the efficiency of an installation can be counteracted by the controllable factor of velocity.

Velocity of fluid can be controlled by the volume of injected gas and selection of equipment that will permit gas to enter the eductor tube in the desired manner and at a most efficient rate. If gas is injected under a column of fluid at a pressure and in volume sufficient to deliver fluid to the surface in a solid piston form and maintain correct velocity, a minimum of aeration, slippage and friction occurs and maximum efficiency is obtained.

The greater velocity the less slippage loss, yet the greater velocity, the greater friction loss. Slippage loss, therefore, must be balanced against friction loss to determine the volume and pressure that will create the most efficient fluid velocity. A maximum efficient velocity has not yet been determined.

Factors—Controllable

1. Loss by escaping gas through imperfect casing, tubing or surface connections. Large quantities of gas will escape through a small leak in a very short time. All leaks should be repaired immediately.
2. Back pressure at point of discharge on the surface. Back pressure might well be defined as unused energy in compressed gas and should be held to a minimum. Chokes, long flow lines and sharp bends all tend to increase back pressure.

Some of the energy contained in compressed gas is not utilized to lift fluid if gas reaches the discharge point under pressure. As an example; a cubic foot of gas expanding isothermally from 400 pounds pressure to atmosphere will perform 7069 foot pounds of work. This same cubic foot of gas, expanding isothermally from 400 pounds pressure to 50 pounds pressure, will perform only 3932 foot pounds of work. Under the latter condition, the gas has expanded 87½ percent of the original pressure but has performed only approximately 55 percent of its maximum energy.

3. In intermitting gas lift operations, a most important factor is selection of a correct controlled injection cycle. Any general conception that a faster cycle and longer injection period will produce more fluid is indeed false, unless a well is operating at maximum fluid capacity. The timing cycle is an important controlled factor to obtain maximum efficiency and minimum gas-fluid ratio. Experimenting with different cycle and injection periods and testing the results will determine the most efficient cycle for either desired allowable production or ability of a well to produce.

This can best be illustrated by the following actual test (Table 1) made to determine the importance of using a correct cycle to secure maximum efficiency and minimum gas-fluid ratio.

In automatic differential or continuous flow operations, accurate control of casing annulus pressure is a most important factor for efficiency.

From a standpoint of total fluid production, mechanical efficiency of a gas lift installation is sometimes of secondary importance.

If the total fluid production of a well is a high percentage of water and a low percentage of oil, then the well might be producing with a low gas-fluid ratio and high gas lift efficiency but have an excessive gas-oil ratio.

Under these circumstances, economics plays an important part. The cost of other types of artificial lifting equipment, that could be used, must be compared with gas lift costs. Capital investment, operating costs, interest rates, payout, etc., must all be considered in the overall economic picture.

Under most conditions, it will be found that gas lift not only is competitive with other types of artificial lifting equipment but is a most economical method of lifting fluid. This becomes

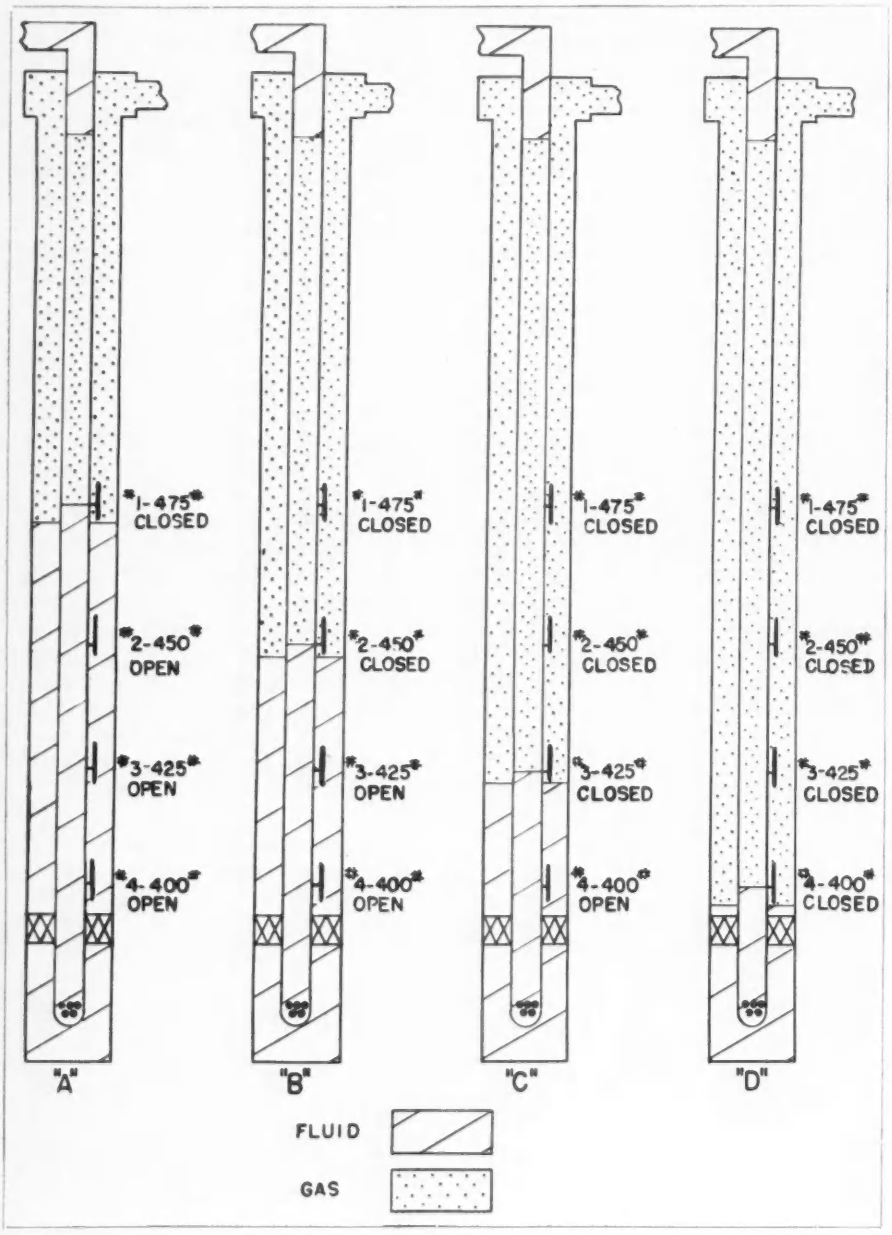

FIGURE 1

TABLE 1

Injection Cycle	Injection Period	Total Fluid	Gas-Fluid Ratio per Barrel
30 minutes	62 seconds	24.39	4,720 cu. ft.
30 minutes	46 seconds	20.31	4,280 cu. ft.
30 minutes	33 seconds	20.31	3,830 cu. ft.
30 minutes	21 seconds	16.23	1,928 cu. ft.
One hour	64 seconds	28.41	2,042 cu. ft.
One hour	44 seconds	28.53	1,533 cu. ft.
One hour	34 seconds	28.44	1,110 cu. ft.
One hour	26 seconds	12.18	2,035 cu. ft.
Two hours	60 seconds	20.31	1,400 cu. ft.
Two hours	46 seconds	20.40	1,082 cu. ft.
Two hours	37 seconds	16.23	1,084 cu. ft.
Two hours	31 seconds	16.23	938 cu. ft.

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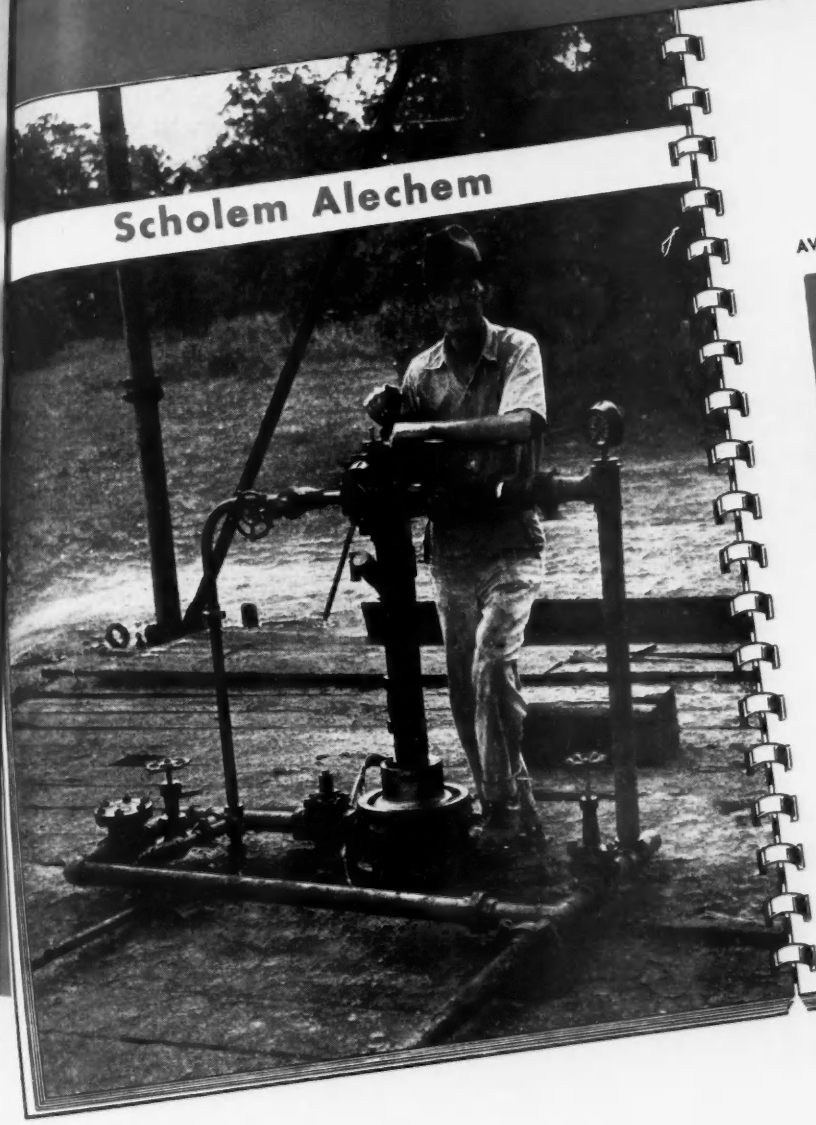
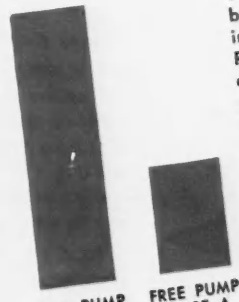


CASE HISTORY

Comparative Production Costs Rod Pump and Free Pump



The figures submitted here were compiled by an operator with two neighboring leases in the Scholem Alechem field, Oklahoma. Producing conditions on both leases are comparable. On Lease B, six wells are being rod pumped. On Lease A, sixteen wells are being Free Pumped. All costs—pumping, pump pulling, paraffin removal, maintenance, and power—were carefully tabulated for a period of six months. The results are shown in the accompanying bar chart and table. The Free Pump wells not only produced more oil—1760 bbls. per month per well compared with 955 bbls.—but their total operating cost per well was lower.

OPERATING COST DATA

	Lease A Free Pumps	Lease B Rod Pumps
Number of wells	16	6
Period covered	6 mos.	6 mos.
Average B/W/M	1760 bbls.	955 bbls.
Cost/W/M	$78.00	$111.00
Total Cost/B	4.5¢	11.6¢

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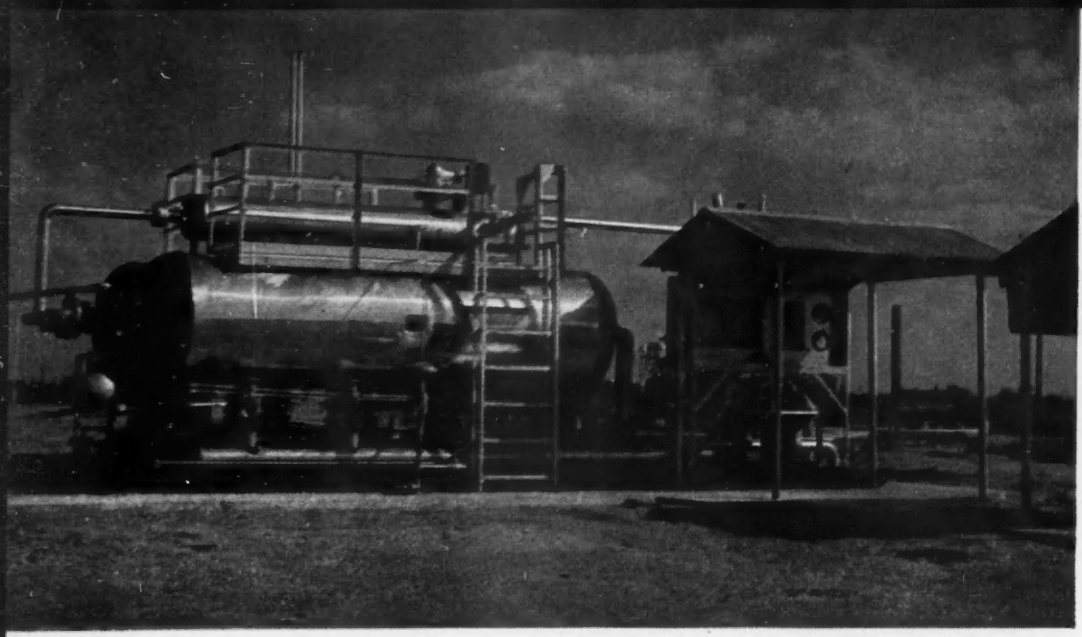

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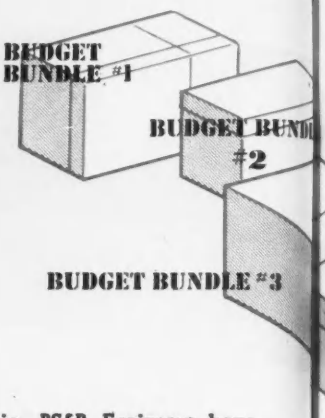

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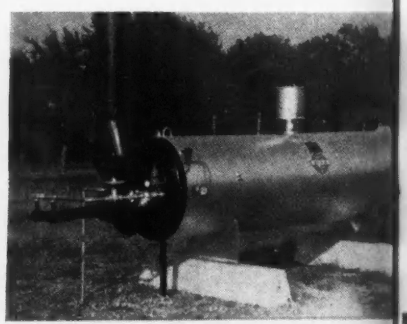

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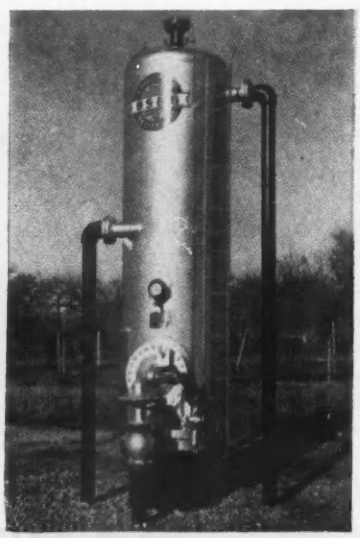

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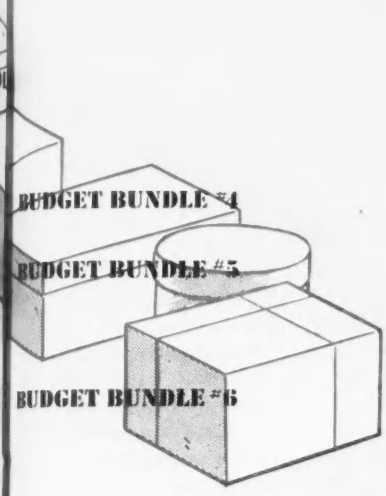

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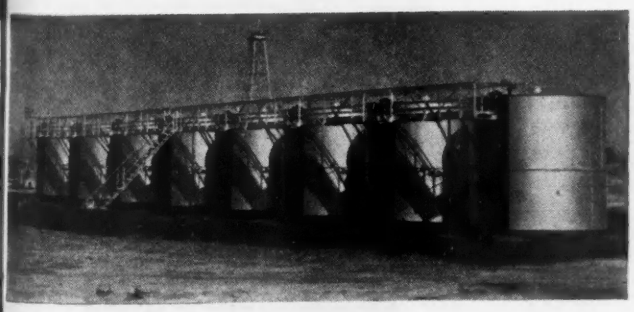

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more and more apparent when producing from the deeper horizons.

Modern gas lift practices and principles must be placed in two separate and distinct categories:

1. INTERMITTING FLOW: (or flow by "slug lifting")

   This type operation consists of injecting gas under a column of fluid at a pressure and volume sufficient to deliver fluid to the surface in a solid column with a minimum of aeration, slippage and friction.

2. AUTOMATIC DIFFERENTIAL AND CONTINUOUS FLOW: (or flow by "aeration")

   This type operation consists of aerating a column of fluid, by injecting gas, to lower the flowing gradient of the fluid column to a point where available flowing bottom-hole pressure, with the aid of expanding injected gas, will deliver fluid to the surface.

The principles of these two types of operation are separate and distinct and rarely do they comingle. Both types, however, have their place in gas lift operations and if individual well characteristics are correctly analyzed and correct type equipment and installation made, the operation will provide satisfactory, efficient performance for the operator.

Therefore, it is necessary that the two types of operation be clearly understood. The equipment must be applied within its limits of operation so misuse and consequent undue criticism of the practice and equipment may be avoided.

Intermitting Flow

This practice is accomplished by controlling gas pressure and volume in the casing annulus between the well casing and eductor tube. Initially, the annulus is freed of fluid, it then becomes a gas chamber for controlling the valve operation. The type valves used are merely back pressure valves, set to open and close at predetermined pressures, to permit passage of gas from the casing annulus into the eductor tube.

When casing annulus pressure is raised to a predetermined pressure, a valve opens and injects gas into the tubing. When casing annulus pressure is bled down, due to injection of gas into the tubing, to a lower predetermined pressure, the valve closes, holding the annulus pressure constant until the operation is repeated.

This operation of opening and closing a valve is termed a "cycle." The number of cycles within a certain period of time are surface controlled to meet individual well requirements.

The intermitting type operation meets a wide range of well conditions and is used in a major portion of wells now being put on gas lift. With various installation methods available, this type valve is very efficient if held within its range of operation.

The range of operation for productive fluid capacity, from a minimum standpoint, includes wells of the lowest possible stripper type, possibly five barrels of total fluid per day or under. The range from a maximum standpoint is limited by the number of injection cycles that can be completed within a 24-hour period and the maximum amount of fluid that can be produced per cycle.

On an average, a cycle can seldom be completed more often than every 10 minutes; however, faster cycles are possible at shallow depths. Under ordinary circumstances, where injected gas supplies the lifting energy, maximum delivery in barrels per cycle multiplied by the number of possible cycles in a 24-hour period determines the maximum fluid capacity of this type equipment.

Allowing for such factors as depth of operation, size of eductor tube, pressure available for operation, and other conditions being average, from an operating depth up to 5000 feet, a maximum fluid capacity may be between 500 and 600 barrels per day. From an operating depth of 5000 to 8000 feet, a maximum fluid capacity may be between 350 and 500 barrels per day. From an operating depth below 8000 feet it is seldom possible to produce over 350 barrels total fluid per day.

Where well production is limited by allowable regulations, the injection cycle can be adjusted to produce only the allowable production.

The range of operating depth for this type valve is presently unlimited. In shallow or deep wells, this type valve is producing most efficiently. Wells are now being produced with the operating valve below a depth of 11,000 feet.

In intermitting operations, as a rule of thumb, the following available surface operating pressures should be used for efficient operation. Of course, local or individual well conditions may permit a deviation from these pressures, however, they may be used as approximate requirements.

Up to a depth of 4000 feet—a minimum pressure of 100 pounds per 1000 feet of depth, with a minimum pressure of 250 pounds regardless of depth.

From a depth of 4000 to 6000 feet, 400 to 500 pounds.

From a depth of 6000 to 8000 feet, 500 to 600 pounds.

Below a depth of 8000 feet, 600 to 750 pounds.

Equipment

There are four major items to consider in selecting the intermitting valve for gas lift operations: 1, hydrostatic pressure; 2, temperature; 3, gas column weight; 4, gas volume passage.

HYDROSTATIC PRESSURE. A valve run in a deep well full of salt water would be subjected to an excessively high hydrostatic pressure before the fluid could be displaced in the casing annulus and the valve exposed to annulus gas pressure. For example, a valve set at 10,000 feet in a hole full of fluid averaging .40 pounds per square inch gradient, would be subjected to a 4000-pound hydrostatic pressure plus the surface gas pressure applied. With some types of valves, this excessive pressure might materially affect the set operating valve pressure.

TEMPERATURE. The effect of temperature on the operating pressure of an intermitting valve is of major importance. If a valve is set to operate at a predetermined pressure at a certain temperature and then run in a hole to operate under a higher temperature, the operating pressure of the valve might be materially changed. The operating pressure of a lower valve may be raised, by temperature effect, to a pressure higher than the operating pressure of an upper valve. When an injection cycle is started, the upper valve will open at a lower pressure than the lower valve, taking the injected gas before the annulus pressure can be raised sufficiently to open a lower valve.

It is imperative, particularly in deep operations, that valves operate at their predetermined pressure under the most extreme temperature conditions. This factor should be given the most careful consideration in selecting equipment.

GAS COLUMN WEIGHT. Weight of the gas column in the casing annulus is also a very important factor in gas lift operations. The gas column weight varies according to the well depth, bottom hole temperature and gravity of the gas. It is sometimes assumed that the weight of a gas column balances the effect of temperature on valve operating pressures. With so many variable temperatures encountered and so many variable factors in the weight of a gas column, it is impossible to consider them as balancing factors. Effect of temperature and weight of a gas column must be given separate and distinct consideration in designing a valve string.

GAS VOLUME PASSAGE. The volume of gas injected under a column of fluid in the shortest possible time to obtain maximum fluid velocity contributes to greater efficiency. With a controlled time injection cycle, a valve with the largest possible injection port permits more accurate control over the efficient volume of gas injected during a cycle.

Efficient fluid velocity must be reached and maintained as a counteracting agent against loss by aeration, slippage and friction. Unless gas is injected under a column of fluid in sufficient volume to maintain an efficient velocity after it has been reached, slippage and aeration loss

will increase materially in the upper part of the eductor tube. Without volume the full use of an efficient operating pressure is lost. In intermitting operations, a valve that snaps open and snaps closed will give better operation than a throttling type valve because it is passing a maximum volume during the entire period it is open.

Basic Principle of Operation

The principle of operation for an intermitting installation, regardless of the valve setting method, is technically the same. The working level of the well is lowered to a desired point, by removal of fluid from the casing annulus, and the well is then produced to production requirements without the upper valves interfering with the operation of the lower or operating valve. The upper valves are used only as unloading valves to remove fluid from the casing annulus and lower the working level of the well to a desired point. During the intermitting cycles of a well on regular production, the upper valves are seldom, if ever, operated.

To illustrate the principle, the decreasing pressure method of setting valves will be used. This is by no means a recommendation that all intermitting valves be set in this manner. The different methods of setting operating pressures of valves, their advantages, disadvantages and applications, are explained in detail elsewhere in this article.

Assume that 4 valves are run in a string. The top valve is set to operate at 475 pounds and the remaining valves are set to operate at successively lower pressures of 450, 425 and 400 pounds respectively (Figure 1).

When the casing annulus is initially pressured up, by injecting surface gas, each valve in the string is closed except those submerged in fluid to a depth where the weight of the fluid column and gas pressure above the valve is in excess of the set operating valve pressure. As the casing annulus pressure is raised, fluid passes from the casing annulus into the tubing through the open valves; the annulus pressure U-tubing the fluid up the tubing.

Figure 1-A. Gas has been injected into the casing annulus and the fluid in the annulus has been U-tubed up the tubing through the open valves. Fluid has been depressed in the annulus to a point where the first or top valve has been exposed to the casing annulus pressure.

With the annulus pressure raised to the opening pressure of this top valve, the valve opens and injects gas under the fluid in the tubing to deliver it to the surface. When the annulus pressure decreases to the closing pressure of the valve, due to injection of gas into the tubing, the valve closes. The surface operating pressure is now recorded as

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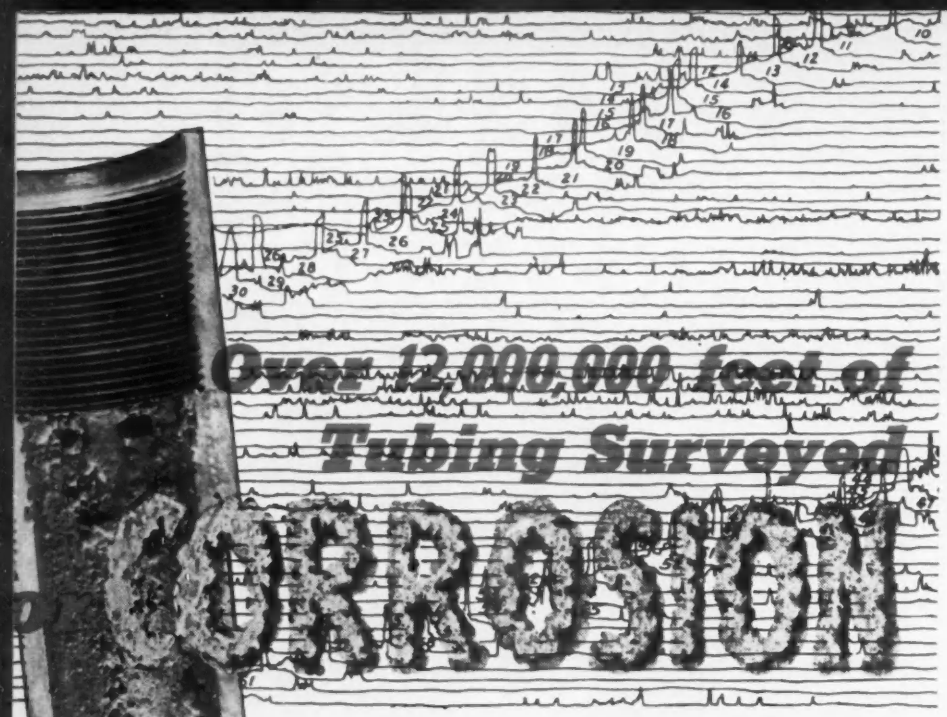

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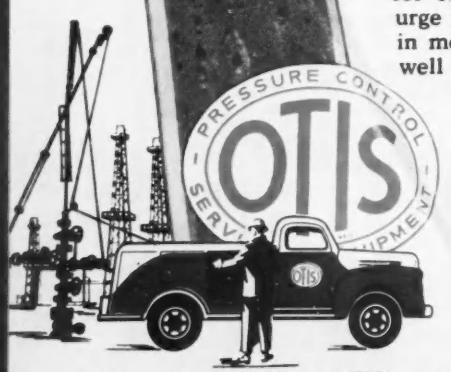
without killing the well or pulling the string for surface inspection

Thousands of barrels of oil are lost annually due to leaks caused by internal corrosion in the tubing and well-head fittings. Wells in highly-corrosive areas have been known to collapse entirely, resulting in expensive salvaging operations and a costly loss of production. It's significant that every year, more and more operators are obtaining surveys of recently-completed wells in order to have a comparison with later surveys to determine the rate and extent of internal tubing corrosion. Otis Caliper Crews have surveyed more than 12,000,000 feet of tubing—*under pressure, without killing the wells or pulling the strings*—and, when necessary, immediately furnished at the well-sites a preliminary analysis of severely corroded joints. Contact the Otis office nearest you for detailed information on Otis Tubing Caliper services, and a sample *"Report of Tubing Corrosion Survey"* and a copy of *"Foundation for Failure,"* a new folder on tubing corrosion. Remember, too, that the entire Otis organization and its staff of pressure control engineers are always available for expert consultation at no obligation. We urge you to use the experience we've gained in more than two decades of specialized oil well service work—*under pressure.*



OTIS PRESSURE CONTROL, INC.

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475 pounds, the valve closing pressure.

This operation of opening and closing a valve by controlled surface pressure, delivery of fluid to the surface and the tubing bleeding down to separator back pressure, is termed a "cycle" of operation. Each cycle must be completed in its entirety before another cycle is started. These cycles are continued until the fluid in the casing annulus has been displaced and the second valve in the string is exposed to the casing annulus pressure.

Figure 1-B. When the second valve is exposed to casing annulus pressure, gas is injected under the fluid in the tubing above it until the casing annulus pressure is bled down to the closing pressure of this valve. This closing pressure is 25 pounds less than the closing pressure of the top valve. The surface operating pressure is now recorded as 450 pounds.

When casing pressure is raised to start a cycle of operation, the second valve will open at a lower pressure than the top valve, therefore, as long as casing pressure is not built up to the opening pressure of the top valve, it will remain closed. Cycles of operation are continued on this valve, within the range of its opening pressure, until fluid in the annulus has been further displaced and the third valve is exposed to the casing annulus pressure.

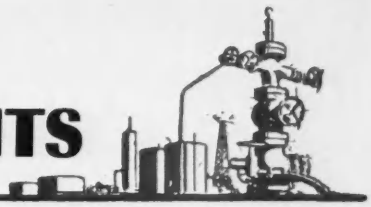
Figure 1-C. When the third valve is exposed to casing annulus pressure, gas is injected under the fluid in the tubing above it until the casing annulus pressure is bled down to the closing pressure of this valve. This closing pressure is 25 pounds less than the closing pressure of the valve above it. The surface operating pressure is now recorded as 425 pounds.

Operating cycles are continued on this valve, within the range of its opening pressure, without opening either of the valves above it. When fluid in the annulus has been sufficiently displaced, the fourth or bottom valve is exposed to casing annulus pressure.

Figure 1-D. When the fourth valve, the bottom valve in the string, is exposed to casing annulus pressure, gas is injected under the fluid in the tubing above it until the casing annulus pressure is bled down to the closing pressure of this valve. This closing pressure is 25 pounds less than the closing pressure of the valve above it. The surface operating pressure is now recorded as 400 pounds. When the 400-pound pressure is recorded, it is known that the bottom valve is in operation.

Frequency of operating cycles and the length of gas injection periods are controlled on the surface, usually by a time cycle controller. The controller is regulated to make a cycle of operation as often as required to meet production requirements or the ability of the well to produce.

PRODUCTION HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Make Cover for High Pressure Line

High-pressure oil which escapes through broken flange gaskets can be prevented from causing injury to men nearby by installing removable flange covers. The covers are made by forming the cylindrical body from short pieces of pipe large enough to cover the flanges without cramping. These cylinders are then split to form equal halves with hinges joining one seam, and lugs for bolts on the other seam. Flat heads, also split to coincide with the seams of the cylinders, are attached to each end after cutting a circular hole to fit the pipe on each side of the flanged fitting.

These flange covers are attached on pipe lines through which high-pressure oil is flowing to confine the stream inside the covers so that the high velocity of the escaping stream will not cut the flesh of persons walking near the equipment either to inspect or repair the damaged flange gaskets. Each fitting, flanged end plug valves, for example, requires 2 flange covers which are similar, if not identical, in construction to cover each end of the valve set in the line.

The assembly of valves and flow regulator is securely anchored by a hold-down which is sturdy and easy to construct. In the concrete foundation is set a short 3-inch nipple capped with a flat piece of plate steel measuring 4 inches on all sides. Four holes in this plate accept the ends of U-bolts fitted around the body of the regulator. When the bolts are screwed down tightly, the regulator and attached fittings are securely anchored in place. The nipple permits easy access to the U-bolt nuts if the regulator is to be removed.

HOW TO—Skid-Mount Light Well Pulling Unit

Where well pulling units are also used to work over wells, the truck on which the unit is mounted is kept out of operation when the unit is on a well.

One operator arranges his unit so that it rests on the bed of a lease truck. If the unit is on a simple tubing or rod job which will require only a day or two, it remains on the truck. However, on workovers requiring squeeze jobs and several round trips, the unit can be skidded off, freeing the truck for other lease work.

The A-frame mast is built on the front of the skids which hold the drawworks, and is hinged approximately 8 feet above the base as shown. This allows the mast to be laid down over the cab where it rests on a support fastened to the front of the skids. The only fastening necessary between the unit and the truck is a turnbuckle between the top of the mast support and the top of the cab guard. When it is necessary to put the unit on the ground, the turnbuckle is loosened and the hook removed.

Before raising the mast, the winch line is run through a block fastened to the pumping unit or well head and the unit skidded off with the truck winch. The mast is then raised in the usual manner with the blocks fastened to the base of the mast.

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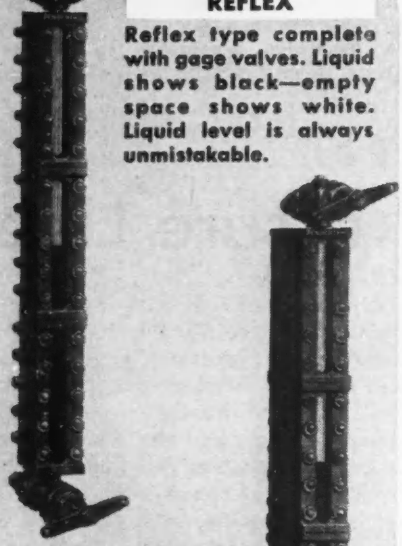
Liquid Level GAGES

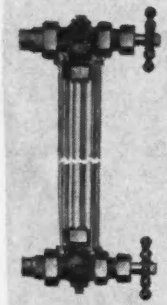
REFLEX

Reflex type complete with gage valves. Liquid shows black—empty space shows white. Liquid level is always unmistakable.



TRANSPARENT

Transparent type complete with gage valves. Used where through vision is desired under high pressures and/or temperatures.



DROP FORGED STEEL

Tubular glass type, Chrome-Moly temperature resisting steel body, stainless steel trim, regrinding removable seats.

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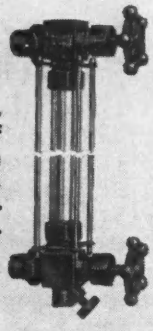
Tubular glass type, extra heavy body of special high strength alloy iron, shanks alloy steel, trim stainless steel, valves self-cleaning.



There is a Penberthy Gage of superior quality for every liquid level gage requirement. Gages are fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. All Penberthy Gages conform with API-ASME requirements.

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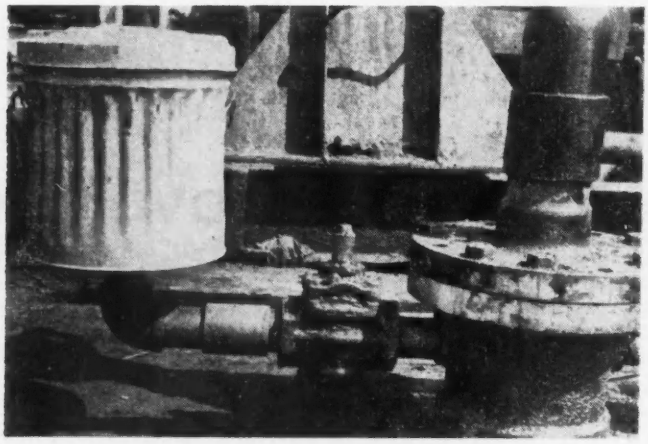
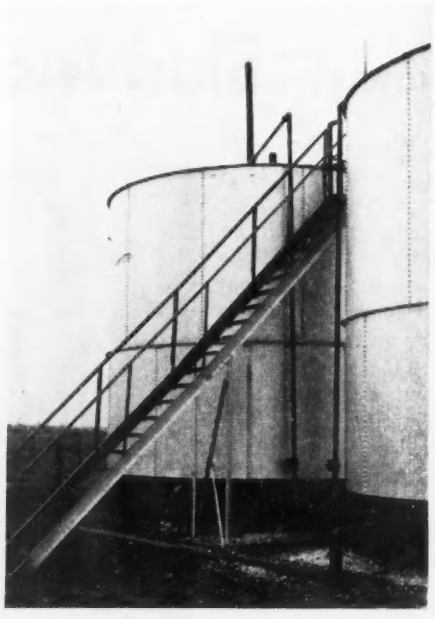
HOW TO—Add Chemical to Casing



Many wells require chemical treatment to keep paraffin in solution as well as to act as a corrosion inhibitor. A system which simplifies the chore of introducing the material into the well uses as a mixing vessel a heavy corrugated galvanized garbage can. A hole is cut in the bottom and reinforced with a bolted 2-inch flange. Two-inch pipe fittings are attached to one of the openings in the casinghead, which contains a plug valve for opening and shutting off the line from the can to the well.

The vessel is placed as close to the well as practicable to eliminate vibration damages and long pipe fittings. The required amount of chemical is poured into this can, which has a capacity of about 5 gallons, and mixed with oil or water as a diluent in the necessary proportions. After mixing has been completed, all the pumper need do is to open the 2-inch plug valve and allow the mixture to flow down the casing. This method prevents spills and supplies a gauge for the desired quantity of chemical, avoiding needless waste.

HOW TO—Hook Up Treating Tank



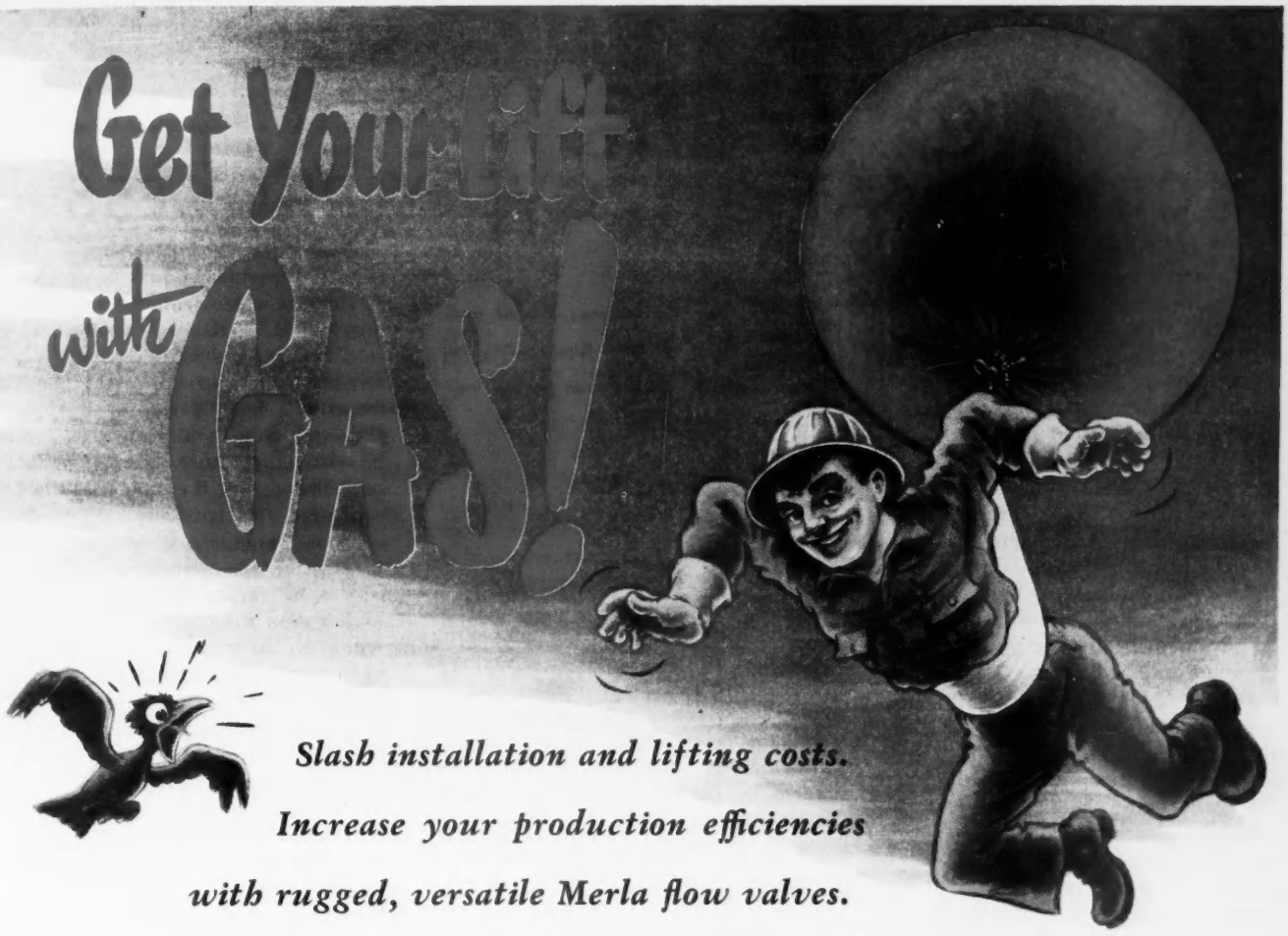
On small leases that do not have a long life expectancy, one of the stock tanks may be converted into a treating tank as shown.

A joint of 4- or 6-inch pipe is run down through the center of the tank. This pipe has windows cut near the bottom end which serve as flumes to carry the emulsion to the bottom of the tank. A tee is placed a foot above the top of tank and the flow line from the separator disconnected from the top of the tank and connected to the tee. The "flume" then extends 6 or 8 feet into the air to carry off all free gas and prevents pressurizing the tank.

A grasshopper leg of the usual construction is then placed on the water outlet and the water level carried approximately 2/3 of the distance up the tank. A connection is then made across the tops of the tanks to take the treated crude to the remaining stock tank.

When it is necessary to put the stock tank on the pipe line, the water is bled down into the gunbarrel so as to provide room for production while the oil is being run from the stock tanks.

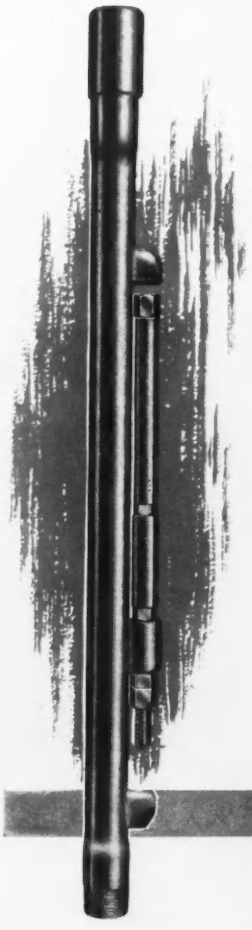
Get Your Lift with GAS!



Slash installation and lifting costs.

Increase your production efficiencies

with rugged, versatile Merla flow valves.



The Merla family of valves features star performers for every operating condition . . automatic differential, continuous, intermitting and dual completion.

Merla valves, constructed of Monel metal, combine strength and toughness with stubborn resistance to sour crudes and corrosion. Durable, dependable Merla flow valves, the product of intensive field research and latest engineering design, are precision manufactured to meet your most rigid standards.

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New
CONDENSATE RECOVERY PROCESS

Hyreco* Unit eliminates Heater and increases stock tank liquid 10% to 25% while operating at greatly reduced temperature.

THE Parkersburg Hyreco Processing Unit, is a completely unitized high pressure gas well hook-up that entirely eliminates the need for a heater. It operates under conditions which provide for the condensation and recovery of from 10 to 25 percent more stock tank liquid hydrocarbons per foot of gas flowed than can be obtained by conventional heater-separator installations. It is the only high pressure well head processing unit of its kind on the market today that offers a record of **proven** performance . . . three years of field testing on the toughest producing problems to be found in any field.

It has long been known that if it were possible within practical limitations to operate gas well separators at very low temperatures, condensation from the gas stream could be greatly increased and substantial gains in revenue would accrue to the operator . . . but previous to the development of the elements of the Hyreco unit such operation was impractical. This was because at very low temperatures much of the water content of the well fluid condensed and formed ice-like hydrates **which quickly clogged** and interrupted the flow of the entire system. When enough heat was applied to maintain safe flowing temperatures, the potential gains from cold operation were lost.

The Hyreco Processing Unit introduces a practical method, now in actual operation on several field locations, in which most of the troublesome water in the gas stream is mechanically removed at high pressure where it exists as a liquid. Having thus removed the basis for the low temperature formation of hydrates, the gas stream can be expanded with accompanying temperature reduction into a specially designed separator. This vessel provides a cold gas zone in which condensation is maintained at a optimum and a warm zone in which the condensed liquid is kept warm by the heat from the well fluid itself.

High pressure well fluid flows directly from the well head to the inside piping in the lower compartment of the specially designed high recovery separator. From here the well fluid, still at well head pressure, flows to the Hydracepter. Here the liquid water, which is the basic cause of freezing upon subsequent pressure reduction, is separated from the gas; as well as the small amount of hydrocarbons which condense at well head pressure.

In the lower chamber of the Hydracepter the water and the hydrocarbons separate. When the level of the hydrocarbons builds up to a specific point, the dry gas recombines with the previously separated liquid hydrocarbons, leaving the water behind. The gas stream then flows through a choke into the cold zone of the high recovery separator. Here the pressure of the gas drops from well head pressure to separator pressure with an accompanying reduction in temperature. At this decreased temperature in the cold zone of the separator the condensation of hydrocarbons is much greater than could take place in conventional separators operated at warm gas temperature higher than the point at which hydrates will form. At the same time, some of the very small amount of water remaining in the gas stream condenses. However, this condensed water along with the condensed hydrocarbons fall to the warm zone of the separator which is kept warm by the incoming well fluid flowing through the inside piping. Thus the possibility of flow interruption due to formation of hydrates is completely eliminated.

The dry, cold gas passes out at the top of the separator. The liquids in the lower warm compartment are dumped automatically into the second stage flash chamber and then pass to the stock tanks exactly as in a conventional stage separator hook up.

Additional data about the performance and application of the Hyreco Processing Unit may be obtained directly from the manufacturer, The Parkersburg Rig & Reel Company, Parkersburg, West Virginia.

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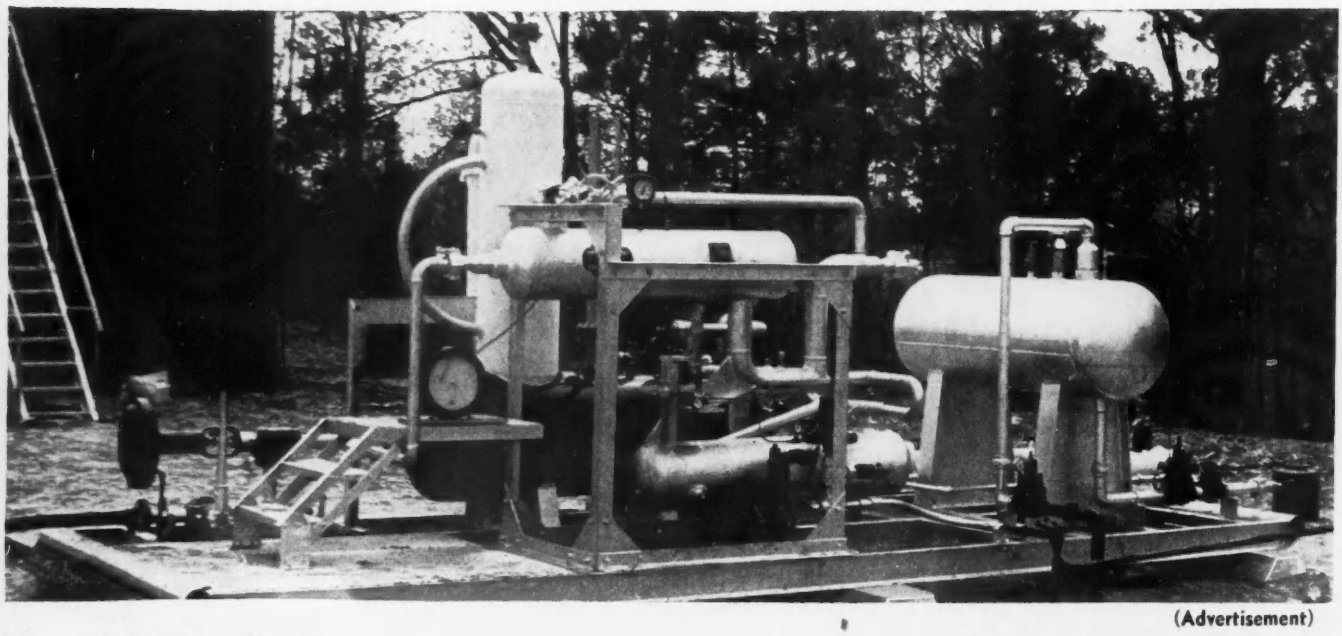

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PARKERSBURG HYRECO PROCESSING UNIT is the only equipment of this type available today that has a record of proven performance . . . ask for comparable evidence about similar equipment.

INCREASED RECOVERY at point of separation, combined with all the benefits of stage separation to decrease the tank loss, is accomplished only with Parkersburg Hyreco Processing Unit.

•

HEATERS ARE UNNECESSARY with the Hyreco Processing Unit, thereby eliminating trouble and the potential danger of fire.

•

NO OTHER SIMILAR EQUIPMENT in use or being offered today can process gas at comparably low separator temperatures.

•

IN SOUTH TEXAS, a Hyreco Processing Unit increased hydrocarbon recovery from 25 bbls. to 31.6 bbls. for each million feet of gas flowed.

•

INCREASED NET EARNINGS UP TO $900.00 per month from condensate sales have been made by users of Hyreco Processing Units.

•

15% INCREASED RECOVERY with the Hyreco Processing Unit meant 137 extra barrels of hydrocarbon in 22 days from one Louisiana well.

•

TANK LOSS OF LESS THAN 1% was recorded on a 24 hour weathering test with the tank hatch wide open. You pipe-line what you recover!

•

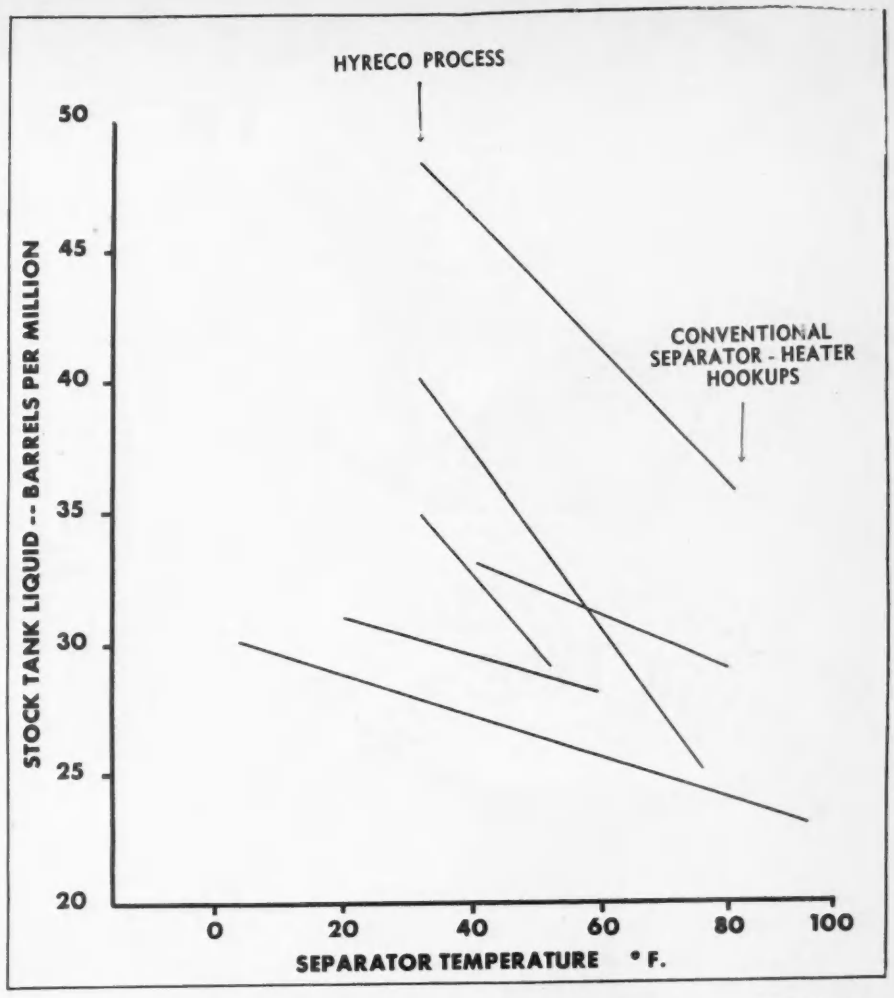
COMPLETELY UNITIZED, compact and skid-mounted, with all piping pre-fabricated, the Parkersburg Hyreco Processing Unit is ready for quick, easy handling and installation.

•

HYRECO UNITS PAY FOR THEMSELVES in a few months . . . thereafter they pay extra dividends that no other installation can match.

•

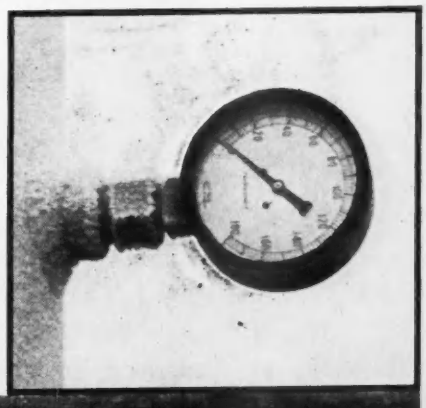
ADDITIONAL DATA available from the manufacturer, The Parkersburg Rig & Reel Company, Parkersburg, West Va.

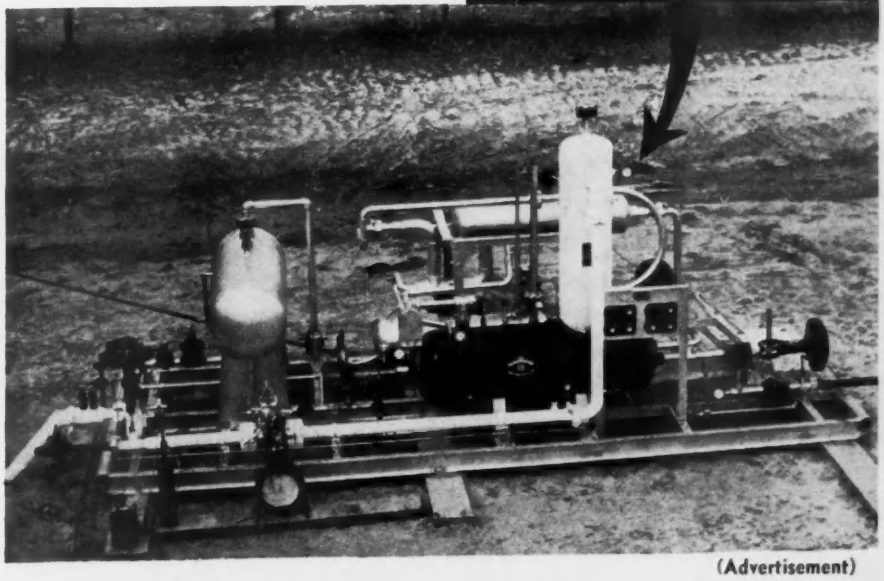


Curves indicate recovered stock tank liquid quantities from different wells produced by Hyreco process as compared to liquid obtained by conventional separator-heater hookups.

•

Enlarged photo of thermometer registering temperature of gas inside cold zone of high recovery separator. The reading is one degree above zero. In the lower photo notice the entire upper compartment of the separator as well as the outlet line is completely coated with ice and frost. The Hyreco Unit is operating perfectly and completely free from freezing while processing gas at this extremely low temperature.





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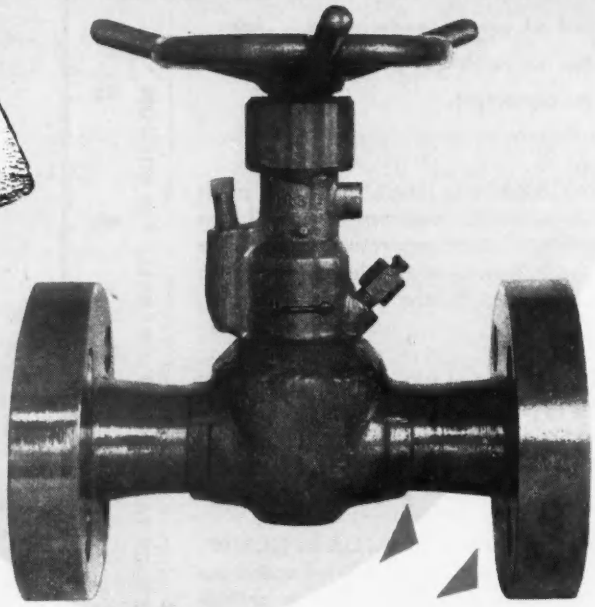
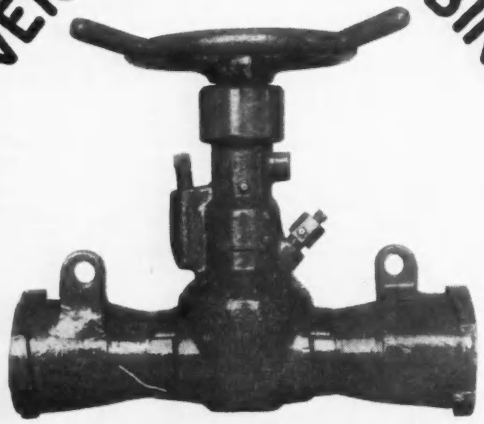
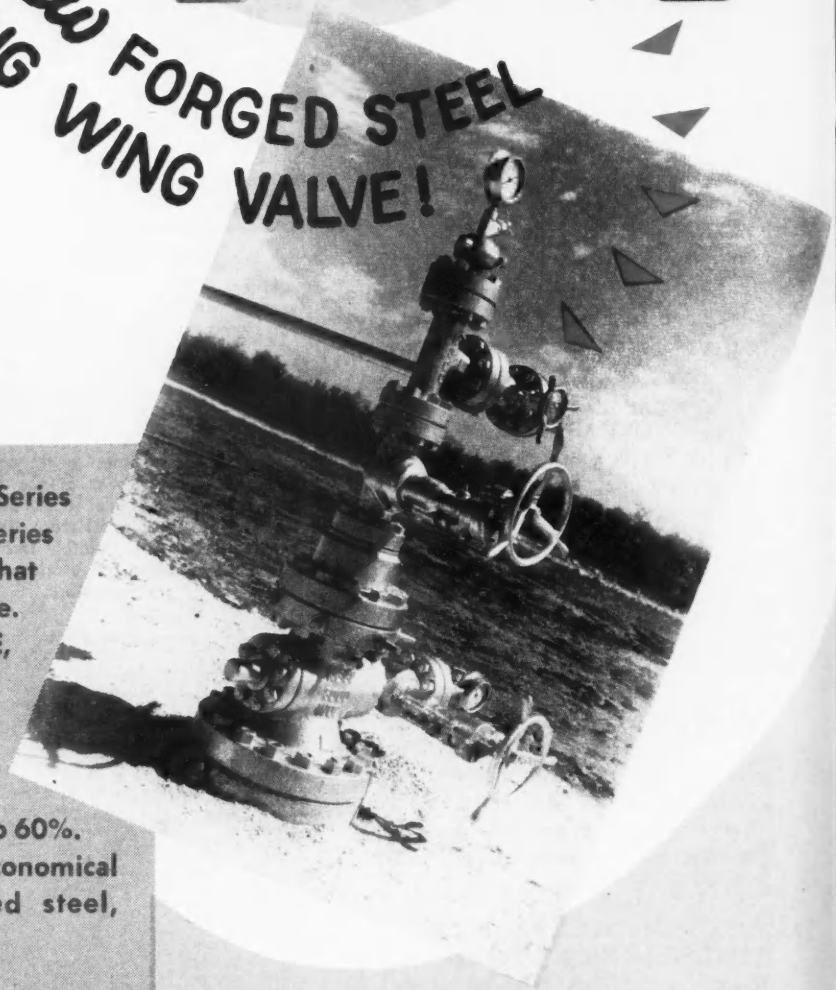
PUT $60 *or more* IN YOUR POCKET



-BY USING ORBIT'S *New* FORGED STEEL VENTURI TYPE TUBING WING VALVE!





Yes the saving is $60 between the 2" Series 1500 TUBING WING VALVE and a 2" Series 1500, full-opening, 6000 lbs. test valve that ordinarily is used on tubing wing service. The ORBIT, forged steel, VENTURI TYPE, tubing wing valve is available in 6000 lbs. and 10000 lbs. test pressures with 2" Series 1500 API flanges or Unibolt couplings for tubing wing service. In 6000 lbs. test pressures the weight saving amounts to 60%. For more compact, lighter and more economical Christmas trees specify ORBIT, forged steel, VENTURI TYPE Tubing Wing Valves.

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ORBIT VALVES

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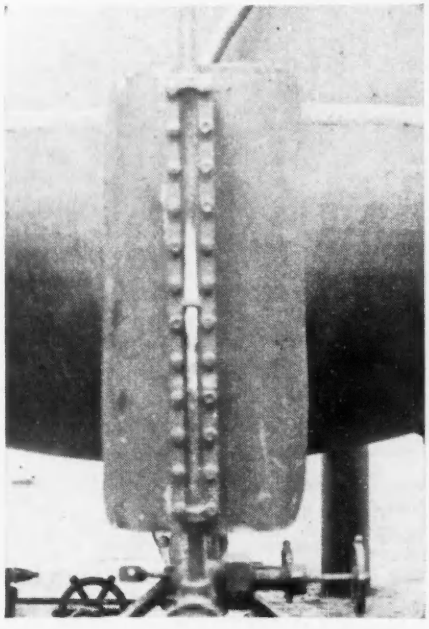
HOW TO—Read Tank Gauge Glass

It is sometimes difficult to determine the liquid level in a glass gauge when the liquid in the gauge is distillate or a light grade of crude. It has often been necessary to place a step ladder by the gauge glass in order to make a close examination of the liquid level.

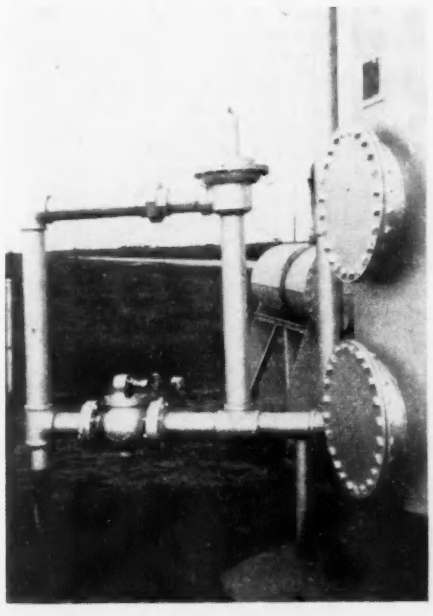


This special device increases the readability of such liquid levels in gauge glasses by minimizing side reflections of light, and placing a source of high-intensity light immediately behind the glass gauge. A short fluorescent tube is used, mounted on the standard bracket but attached to the gauge glass body. The tube is painted black from end to end with the exception of a strip about ¼-inch wide extending its full length. The unpainted strip faces the gauge glass.

To eliminate as much side glare from the sun as possible, side wings are added. These wings are a single sheet of metal about the same length as the liquid level gauge and about 10 inches wide. It is bent along the long axis so the side pieces curve around the gauge. With the fluorescent light burning, it is easy to measure the liquid level in the gauge regardless of the type of fluid stored. This device eliminates possible errors and makes the liquid level reading simple.

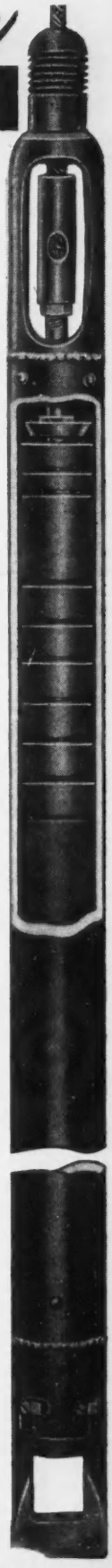
HOW TO—Hook Up Relief Valve

Where heater-treaters are used as separators on oil leases, the relief valve should have a line which will place the outlet far enough from the flames to prevent a fire in case the valve should pop. One operator connects the pop valve back into the vent line on the down-stream side of the back-pressure valve. This line is connected to the burning pit or salt water disposal pit and is always open ended.



The connection is made by placing a tee ahead of the back pressure valve and the relief valve on top of a 3-foot nipple. On the down stream side of the valve, a tee is installed "bull headed" with one side connected to the vent line and the other running back up to the outlet of the relief valve. The back-pressure valve is always set at a lower pressure than the relief valve, but when excess pressure is placed on the vessel the relief valve pops. If the excess pressure is caused by the heater-treater's being flooded with oil, the line from the relief valve carries the fluid to a safe distance from the fire before discharging it into the atmosphere.

Miller
SAND PUMPS



In every major producing area where sand or sediment is a problem, you'll find Miller Sand Pumps and Bailers are standard . . . the leaders in clean-out equipment. For 26 years Miller has held this leadership, with continuous improvements and faithful service.

The Miller Sand Pump is made in regular and heavy duty types in sizes listed below. Lug type, chisel, sand and bailer bottoms are easily interchanged.

SAND PUMP and BAILER SIZES:

Outside Diameters

2½"
3"
3½"
4¼"
5"
5½"
7"

Lengths

20 feet
25 feet
30 feet

Special Sizes and Lengths Made to Order!

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue Page 3305 for details.

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The SURE, LOW COST
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CRALL
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PARAFFIN SCRAPERS
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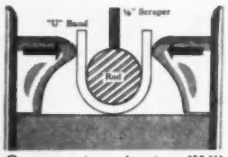
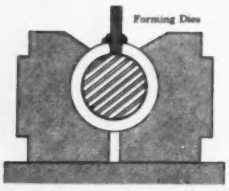
CRALL Spiral Pariffin Scrapers are designed to fit any sucker rod, for 2" or 2½" tubing. Millions of feet of CRALL Scrapered Rods, installed in thousands of pumping wells throughout the United States and Canada, are operating to the complete satisfaction of our customers.



Cross section showing "U" band being die-formed around rod to the scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade. Neither Scrapers nor Bands are welded to the sucker rod.

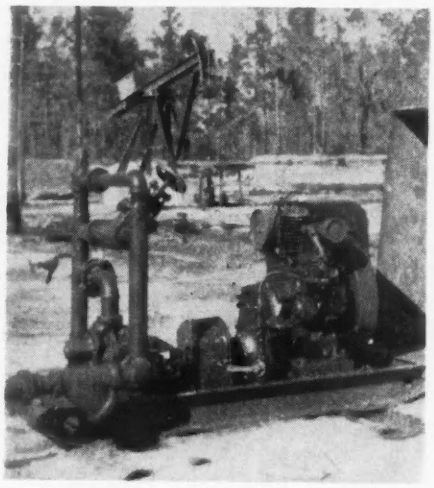
1. **Scrapers alternate—one right, one left—eliminating tendency of rod to unscrew.**
2. **Scrapers are attached at our plants and shipped direct to you or stocked at supply stores.**
3. **Pass Scrapers every pump stroke, up and down. Rod string does not rotate.**

The original installation is the only cost. Order your CRALL Spiral Scrapered Rods from your supply store or wire, write or phone for full descriptive literature.

PETROLEUM SPECIALTY CO.
P. O. BOX 1640, PAMPA, TEXAS

Manufacturing and Fabricating Plants at Pampa and Sundown, Texas

HOW TO—Connect Pump Manifold



Small skid-mounted pumps powered by gas or gasoline engines are occasionally needed in the field to transfer oil from one tank to another or to move it into a booster station for pipe line delivery. The unit shown has been used for this purpose and many others with satisfactory results. Outstanding is the manner in which the pump suction and discharge lines are manifolded to provide a maximum of protection against damage.

The pump is a rotary gear type, and is protected on the upstream side of the suction line by a strainer, shown connected in the foreground. The discharge is flanged to the manifold about 1 foot above the discharge line so that when the pump is shut down, fluid will always remain in the pump to provide a prime when it is started again.

Note that the discharge line is connected back into suction through two parallel lines which pass over the top of the pump. One line is equipped with a valve which permits manual bypassing or recirculation between the discharge and suction of the pump while it continues to operate and when the downstream line is closed. The second line includes a pressure relief valve which serves as a safety check against overloading the downstream side of the pump with pressures in excess of the operating pressure of the pump. If the discharge line were unintentionally closed, the pump would continue to operate but the fluid would pass through the pressure relief valve and back into the suction line. An air bleeder valve is attached to the discharge line on the far riser. It is ½-inch connection.

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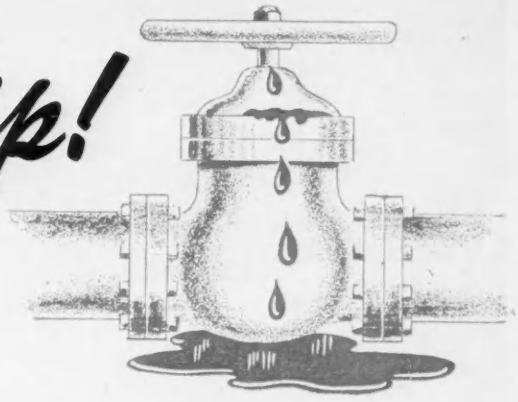


By J. R. (DICK) ELLIS
Vice President, Sunray Pipe Line Company

THE AUTHOR surveys the losses sustained through various types of leaks, and makes recommendations for avoiding or minimizing them. Tanks are classified for types of contents to be stored, and the effect of uncontrolled evaporation set forth.

WE ARE all familiar with the classic story of the brave little Dutch boy who plugged the leak in the dike and saved the city.

In like manner, millions of barrels of oil are saved annually by timely plugging of leaks in and around the hundreds of thousands of producing oil wells in the country as well as their attendant installations.

Oil is hard to find and expensive to produce. No oil leak, however small, should be overlooked. Consider the fact that oil leaking at the rate of one drop per second equals 33.73 gallons loss per month; a tiny trickle can equal 577 gallons loss per month; and a small stream can cause the loss of 1350 gallons of oil during the same period.

All Leaks Costly

Sunray Pipe Line Company is called upon to "stop that drip" and is fully aware of the need for careful attention. Employes know that thousands of dollars of Sunray's products would disappear annually unless they realized that "There is no such thing as a small leak." Nationwide, this loss could amount to millions of dollars which would have to be borne by the individual companies, if employes failed to take prompt remedial measures to "plug the hole in the oil dike."

Oil, from the time it leaves the well until it reaches the ultimate consumer, is striving to escape through leaky valves and pipes, or by evaporation. Underground oil has long been conserved by the application of scientific production methods. However, it is essential from an economic standpoint for field men to work constantly and with equal vigor to conserve oil aboveground. This is particularly significant at this time when crude allowables are being cut in almost every oil-producing state.

Oil, being a liquid, behaves like a liquid; it seeps through loose joints and valves; it leaks from imperfect tanks; it spills when carelessly handled. But its main route of escape is through evaporation. Field men know that oil is a volatile substance and the lighter fractions, such as gasolines, must be carefully guarded or they will evaporate. Even relatively stable crudes release some of their volatile and valuable components into the air under certain conditions.

The saving of every possible drop of aboveground oil begins at the well. Because the first flow of oil from a new producer is laden with mud and other impurities it was common practice a few years back to turn the initial flow into a pit to be burned. This wasteful practice is rapidly being discontinued and oil-saving minded organizations no longer burn scores of barrels of valuable oil but install treaters to remove the impurities.

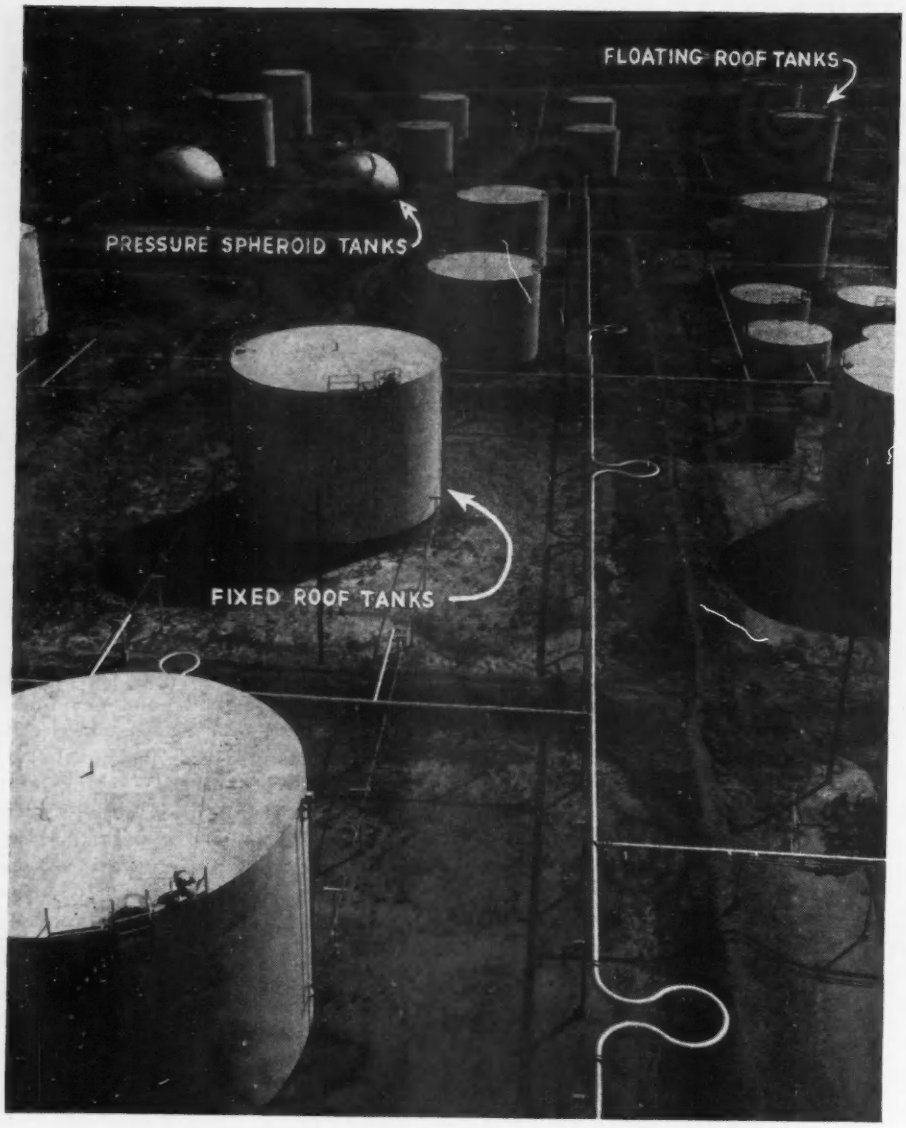
Reducing Leakage

Leakage in pipe line transportation has been greatly reduced by the use of welded joints, replacing the old screw-coupled joints, and this is recommended wherever possible as an important oil conservation measure. Line walkers are constantly patroling and, since the war, some companies have instituted pipe line air patrols which spot oil leaks from a moving plane and report back by radio so that measures to stop the leak may be taken without delay. Pipe lines today are coated and protected and this prevents many leaks which occurred because of corrosion when lines were installed without protective coating.

Pipe line losses can further be reduced

About the Author

J. R. (DICK) ELLIS, vice president of Sunray Pipe Line Company and manager of the pipe line division of Sunray Oil Corporation, has been with Sunray since May, 1947. He started in the pipe line industry with Great Lakes Pipe Line Company in 1934, serving successively as laborer, gauger, district clerk, terminal superintendent, and engineer. As field engineer, he assisted in construction of new lines in Kansas, Nebraska, Minnesota, and the Dakotas. He was transferred to Oklahoma in 1947 to construct the line from Tulsa to Allen, Okla., and joined Sunray upon completion of the line. He was born at Miami, Okla., April 4, 1910, and attended Oklahoma A. & M. College.



Portion of a Sunray Oil Corporation tank farm showing several different types of storage tanks used to store petroleum products and reduce loss.

by the adoption of operating methods which minimize the filling and emptying of tanks, such as the use of meters for oil-measuring purposes. In the past, thousands of dollars worth of petroleum products were sometimes lost by careless or inaccurate measuring. Today, however, hourly checks of the quantities pumped through the trunk lines by gauging storage tanks at the originating and receiving stations make early detection of shortages possible. In most cases gauges are obtained by automatic remote reading gauges which are more accurate for hourly check gauges than the old method of climbing to the top of the tank to obtain a hand-line gauge. Constant observation of pressure gauges at the pump stations should be maintained, as this provides early indications of any leaks that might occur.

Evaporation losses in the loading of tank cars can be virtually eliminated by extending the loading pipe almost to the bottom of the tank. This "bottom loading" causes the lower end of the pipe to be quickly submerged by the rising liquid thus preventing the lighter fractions from escaping into the air.

At Sunray's refineries (or at any refinery, for that matter), the numerous tanks and miles of pipe offer many opportunities for escape and make loss-prevention a large-scale operation. Thousands of joints and hundreds of pumps are constantly watched for leaks. Measurements are taken at many points and losses from processing pipes or units or tanks are quickly detected.

Evaporation Losses

As previously stated, the greatest loss in the handling of oil and oil products is through evaporation. This hazard exists particularly in the large storage tanks where products are stored in readiness for transportation.

The most common type of storage tank in use is the fixed roof tank and this type is favored because of simplicity and economy in construction. It is used at the well, along the pipe line, and at refineries for the storage of crude and heavy products, with more volatile products being stored in special tanks.

Tanks used to store gasolines and other lighter fractions must be so constructed that vapors can expand. If means are not provided to contain these vapors, it adds to the evaporation loss and may amount to as high as 2 percent of a tank's capacity in a year's time. Thus in one tank of 3,360,000 gallons capacity, as much as 67,000 gallons may vanish in a year.

A number of methods have been developed, and are recommended, which reduce the evaporation losses from tanks. By painting with white or aluminum paint, tanks used for gasoline storage reflect much of the sun's heat and evaporation may be reduced by as much as 50 percent.

Retaining Vapors

Where losses can normally be expected to be heavy during long stretches of hot weather, it is recommended that the vapor spaces of several tanks be connected to an expansion or lifter roof tank or a gas holder. This will retain the vapors exhaled due to breathing or filling until they can be returned to the tanks when temperature is lower or a tank is emptied. Excess vapor can be led to a compressor which liquefies it to be returned to the storage tanks.

A "floating-roof" type tank, although representing a higher initial cost than the fixed roof type, further reduces evaporation losses. The roof of this type of storage tank floats directly on the liquid contents, rising or falling as the tank is filled or emptied. With practically no vapor space, evaporation and filling losses are all but eliminated.

More volatile products, such as butane and propane, pose storage problems which in turn have resulted in the development of new type pressure tanks designed to hold these light ends or gases in liquid form. Sunray's experience indicates that these pressure spheres, resembling large inflated balloons, virtually eliminate evaporation losses.

Loss control is a big job in the oil industry. At Sunray it is a day-by-day and even hour-by-hour task in which every field man participates. Oil must be guarded constantly from the time it leaves the well until it reaches the consumer. Losses may be a little here and a little there, but, unless constantly controlled, they represent appreciable financial losses which no operator can tolerate.

Criteria for Cathodic Protection

BASIC CONSIDERATIONS leading toward determination of proper protection for pipe line installations are discussed, and recommendations are made for proper protection through the use of sacrificial anodes. The difference between costs with bare and protected or coated lines is emphasized.

IN DETERMINING the means of protection from corrosion for buried metal structures, the economic aspects of no protection, mechanical protection in the form of wrappings and coatings, electro-chemical protection through either an external power source or the use of galvanic anodes, or a combination of mechanical and electro-chemical protection should be considered. Assuming that some form of corrosion protection is necessary, the problem usually becomes one of designing for a combination installation, as there is no coating which alone gives complete protection, and cathodic protection by itself often is uneconomic due to the heavy current demand for protection of the bare metal.

The customary procedure now is to prepare a tentative design based upon assumed current requirements for protection of the structure; then, following field application tests, the final determinations are made.

Of the several recognized criteria for complete corrosion protection, that based on current density, attempting to establish a value of current per square foot of metal surface which will be adequate under a given corrosion exposure, is in common use as a guide for estimating the current requirements prior to application. Indicated current values required to protect bare steel in natural soils and waters have been found to range from 0.5 to 5 milliamperes per square foot. For coated steel, the values range between 0.01 to 0.5 milliamperes.

Economy in Application

The actual installation usually is made on the basis of the preliminary estimate of current requirement and the criterion of pipe-to-soil potential then is applied for determining whether or not the proper degree of electrical protection has been achieved. This usually requires only a single instrument reading at each selected location with no further calculations. It has proved adequate for the customary installation.

In the field these potential measurements customarily are made using the copper/copper sulfate half-cell as a reference. The half-cell may be placed directly over the buried structure and is coupled to the structure through a high resistance voltmeter. When sufficient current has been applied to the buried structure that its potential as measured against the half-cell reaches a value of —0.85 volt, adequate current for cathodic protection is assumed to be present. This value of —0.85 volt, while an arbitrary quantity only, has proved its adequacy on pipe lines on which it has been maintained and is accepted by many corrosion engineers.

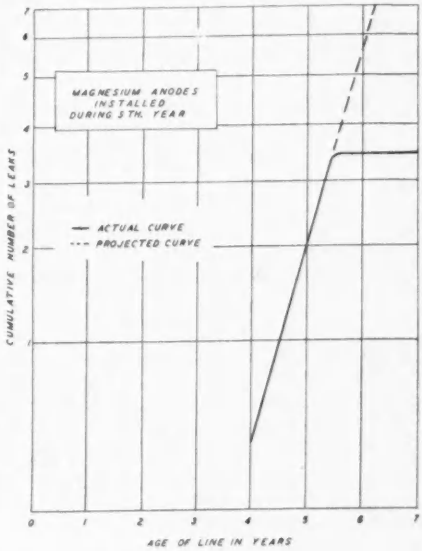


FIGURE 1

In a design for complete cathodic protection and employing the value of —0.85 volt as the minimum potential necessary at all points on the structure to afford corrosion prevention, it is seen that any higher negative value potential would represent wasted current. As the pipe-to-soil potential theoretically will be at a maximum at the point of current drain from the line (point of cathodic protection installation) and decrease exponentially along the structure from this point, it also is seen that the intervals between the drain points control the amount of wasted current, after the surface area of the structure, effect of the coating and resistivity of the soil, have been considered.

In order to achieve maximum current economy, then, and still maintain the minimum —0.85 volt potential on the structure, it is necessary to space the cathodic protection installations relatively close together which will allow less potential at the point of each installation, draining less current at these points to achieve protection all along the structure. As the spacing between these drainage points decreases, the total current demand decreases until a point is reached where further decrease in the spacing is of no value. The minimum spacing depends upon a number of factors and varies considerably from structure to structure. But, for all installations, current economy can be achieved by proper spacing of the current drain points.

An economical type of power source which can be applied in closely spaced small units is the galvanic anode. In application the anode is buried beside the steel structure and connected to it with a wire. When coupled in this fashion the anode will release electrical energy to the steel structure in the same fashion that the case (anode) of a dry cell battery releases energy to the carbon rod (cathode) when the battery has

been short-circuited across the terminals. The anode metal is gradually consumed in the process.

Magnesium for Current Source

The quantity of anode metal which will be consumed to protect a buried installation for a given length of time depends primarily upon the amount of current necessary to achieve the assumed pipe-to-soil potential of —0.85 volts at all points on the structure, which in turn depends upon the surrounding environment and the coating on the structure, if any. Assuming that a given structure would require a current density of two milliamperes per square foot of surface to achieve corrosion protection, in one year's time this would amount to 17.52 ampere-hours of current per square foot. Assuming that the structure had 1000 square feet of surface area, the current requirement for one year to protect the structure would be 17,520 ampere-hours.

Employing magnesium metal in the form of anodes to supply a current of 17,520 ampere-hours would require that 35 pounds of magnesium be consumed, at the available current capacity of 500 ampere-hours per pound of magnesium consumed, when installed under normal field conditions. This amount of magnesium would represent approximately two 17-pound anodes.

Many operators are faced with the problem of reconditioning their present pipe lines or sections of line which have not previously been cathodically protected from corrosion. The most economical reconditioning program in these situations must be dictated by several factors, the primary ones being the present condition of the lines and the service they must perform. Obviously, the only course to follow on badly corroded sections where the existing operating pressures must be raised is replacement of the pipe.

On many sections of line, however, it is possible to obtain years of service from the pipe by arresting the progress of corrosion. The problem then becomes one of economy to determine the remedial action which will do the job at the lowest cost. Considering an average case, it may be assumed that the cost of reconditioning 1 mile of bare 8-inch line will be approximately $10,000, which will include lifting the pipe, cleaning, coating and putting it back into service. This is a sizable expense and even after these remedial measures have been taken there is no assurance that future trouble will not develop along the line.

This same section of line can be cathodically protected against corrosion through magnesium anodes. One mile of 8-inch line represents 11,915 square feet of metal surface to be protected. Assuming that each 17-pound anode will deliver 100 milliamperes of current in the average soil condition presented and that each square foot of metal surface will require 1 milliampere current flow for protection, the line would require the installation of 119 anodes to supply the necessary current. Assuming 500 ampere-hours of useful current for each pound of magnesium metal consumed, each anode would have a life of approximately 10 years. Assuming an average cost of $15 per anode installed in this instance, the cost for complete cathodic protection of the line for 10 years would be approximately $1785.

Magnesium Supplements Coatings

Corrosion concentration cells are set up at any breaks or pinpoints in the coating of a coated line and corrosion is very rapid at these points. But, due to the fact that the area to be protected is low with respect to the total surface of the pipe, the number of anodes is correspondingly less for the coated than for the bare line. Considering these factors, it is seen that the added step of cathodic protection is inexpensive insurance. On a well-coated line the current requirement will be about 0.01 milliampere per square foot. Using the example of 1 mile of 8-inch line, this would represent a current requirement of around 10,420 amepere hours over a 10 year period, or the current equivalent of approximately 1.2 17-pound magnesium anodes. The cost per anode installed increases as the number decreases, but assuming a cost of $20 per anode installed in this instance, the cost per mile of line would be only $24. Where conditions are such that larger anodes may be employed advantageously, the costs per pound of metal installed are proportionately less. For the wrapped line that has seen a number of years service, there is more area to be protected employing more anodes with a resulting higher cost. Assuming six times the cost for the new coated installation, the figure would be $144 per mile as a fair average for a coated line which has been used several years.

For new coated line installations where cathodic protection is to be employed, the anodes should be installed promptly. Such action will prevent corrosion gaining a foothold and insures a more economical protection system than will be required at a later date.

Hot-Spot Protection

Many operators now are employing "hot-spot" protection, or the installation of magnesium anodes at locations along the line where experience dictates that corrosion troubles will be encountered. River crossings and crossings under roadbeds are notorious from this angle, while trouble usually can be anticipated at any section where there are distinct changes in soil structure.

In such instances no extensive engineering or surveys are involved as a general rule. Several anodes are installed at the predetermined hot-spots or strung closely adjacent to them to obtain a concentrated electrical coverage in their immediate vicinities only.

Another method which in essence is hot-spot protection is being employed advantageously by some operators to cut down their leak-incident rate. This method, also requiring no engineering or surveys, is to install magnesium anodes at those points along the line where leaks have occurred in the past.

A leak encountered at a particular section of the line usually indicates concentrated corrosion attack in that immediate area and the probable recurrence of trouble at that point. Many operators now consider it standard practice to install from 2 to 3 magnesium anodes at all leak sites at the time of the leak repair, finding that procedure much less expensive than to go back again and repair the line at the same point, or completely replace the section.

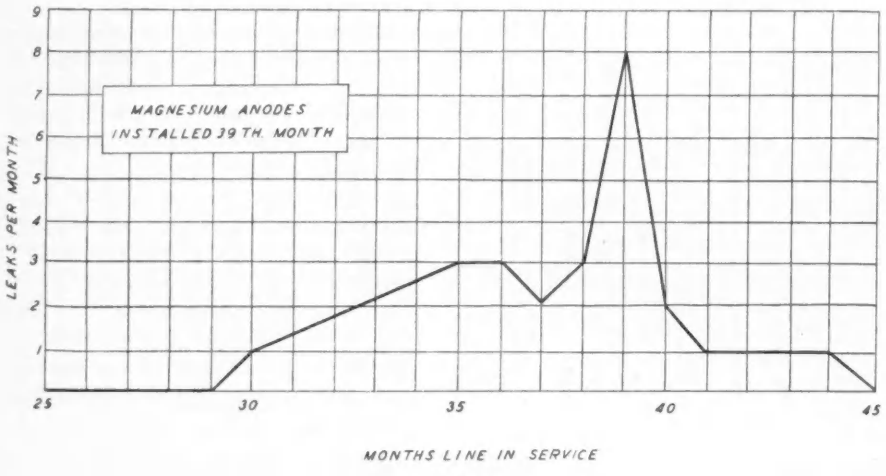


FIGURE 2

A Bibliography On Cathodic Protection

By F. A. ROHRMAN

Executive Director, Engineering Experiment Station University of Colorado

THE following bibliography on cathodic protection consists of more than 400 inclusions and presumes to include every paper pertinent to the subject from 1842 to the latest available sources of 1949.

This bibliography attempts to cover the subject in foreign as well as U. S. publications. The material is arranged by the year and then alphabetically by the authors under each year. In order to make the material more readily useful each inclusion is preceded by the letters (A), (E), (G), (M) or (Z) which establish the main nature of the treatment of each paper. The letter (A) will mean that the main import or subject matter of the paper refers to aluminum, (M) to magnesium, and (Z) to zinc as anode materials. The letter (E) will indicate that the paper treats most specifically with external electrical means of cathodic protection or with resistivity measurements, electric connections, cells, etc. (G) covers the more general aspects of cathodic protection and also those cases where more than one type of anode (Al, Mg, or Zn) is discussed.

All references attempt to establish in a uniform order the author, or authors, the title of the paper, the journal, volume, page, and year.

It is realized that errors may be present despite many days of research and checking on this bibliography. It is also possible that some worthwhile papers have been omitted. The writer would greatly appreciate information of such errors and omissions, as it is intended to accumulate and publish additions each year in order to strengthen the useful literature on this important subject.

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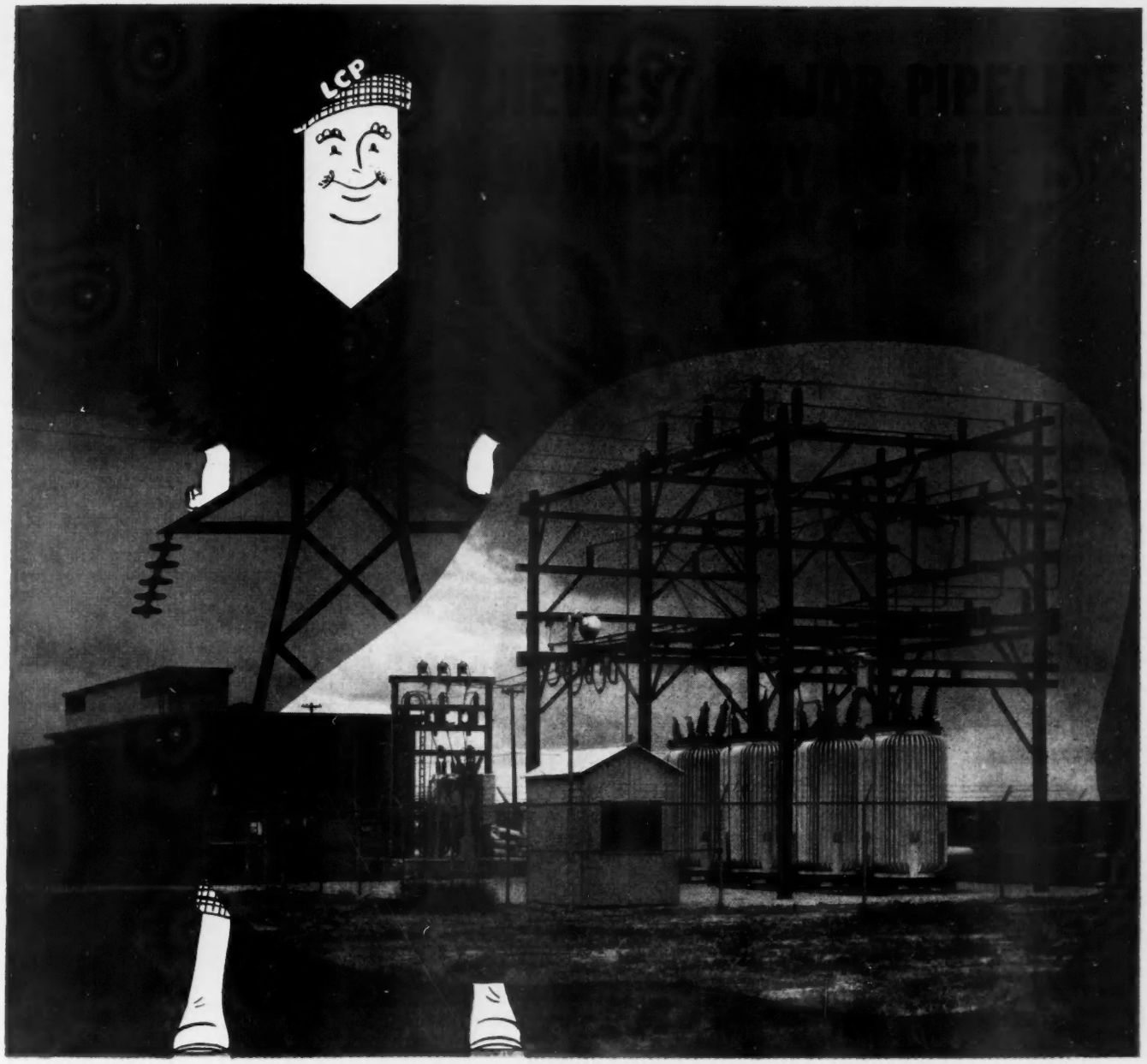

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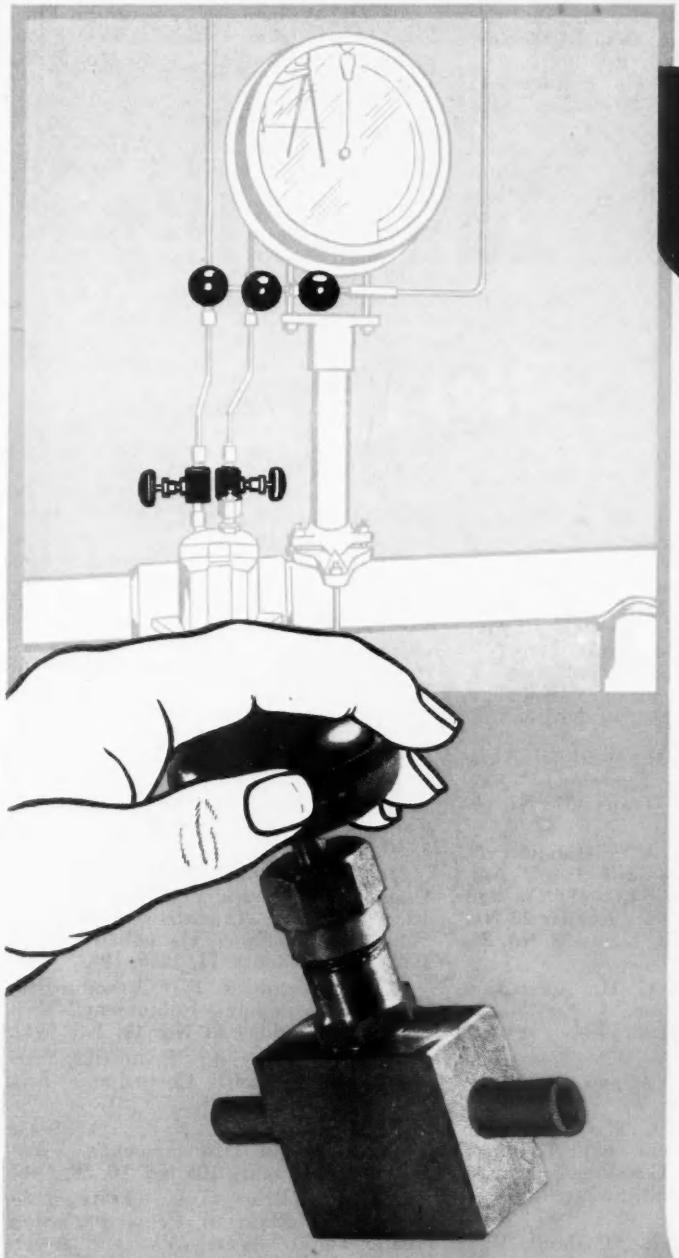

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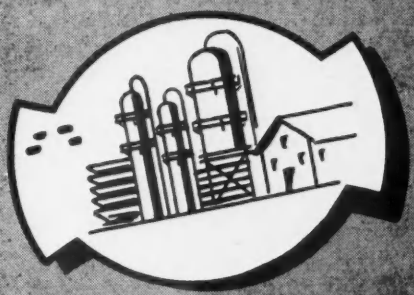

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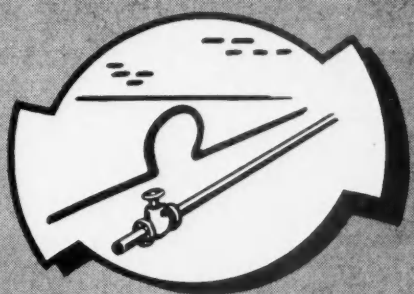

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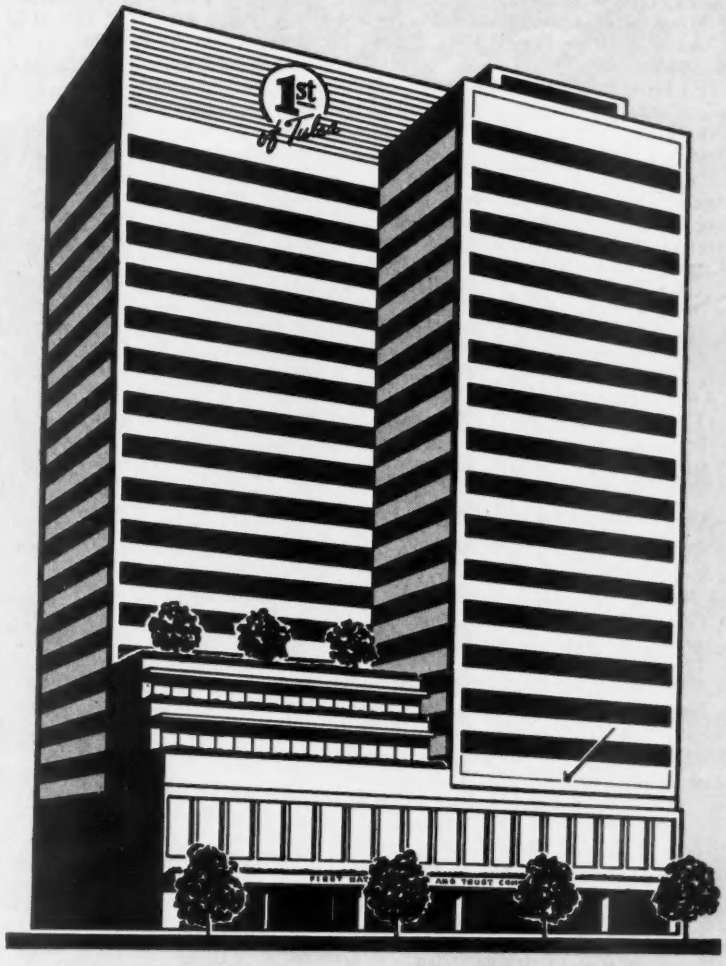

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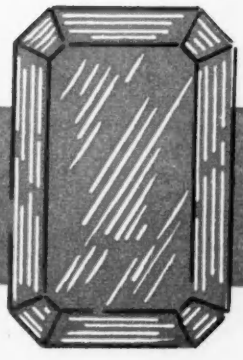

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PIPE LINE *Construction*

By SYLVIA LILLIE
Staff Writer

Projects Announced and Contracts Awarded

Crude Oil Lines

Condor S. p. A. has announced plans for an 80-mile line from Genoa to Rho, near Milan, Italy.

The Ohio Oil Company proposes to build 330 miles of 20- and 22-inch from Wood River, Ill., to Lima, Ohio, with 202 miles scheduled for fall, 1950, construction.

The Ohio Oil Company has applied to Wyoming Public Service Commission for permission to build a 21-mile, 12-inch line from Elk Basin field to Ohio's station at Byron, Wyo.

Natural Gas Lines

Consolidated Natural Gas Corporation plans a 164-mile main line from Boom, Penn., to Cortland, Ithaca, Schenectady, and Albany, N. Y. Work is scheduled to start late in 1950.

East Ohio Gas Company has been authorized by FPC to construct a 24-mile, 20-inch line from TGT's facilities at Petersburg to East Ohio's Austintown, Ohio, station.

Equitable Gas Company has applied to FPC for authorization to increase its system 21 Mmcf per day by building a new compressor station containing 4 units of 880 horsepower each, and 17 miles of 6-, 8-, 12-, and 16-inch line in the vicinity of Waynesburg, Penn.

Grand River Gas Transmission Company has an amended application before FPC for permission to build 69 miles of 10-inch from TGT's line at Meadville, Penn., through Austinburg to Fairport, Ohio; and 7 miles of 8-inch from Austinburg to Ashtabula, Ohio.

Humble Oil & Refining Company will build 8 miles of 10-inch near Katy, Texas when pipe becomes available. Dewey Miller Contracting Company, Wharton, Texas, has been awarded the contract.

Iroquois Gas Corporation has FPC authorization to build 23 miles of pipe line into Holland, Erie County, and Bennington, Wyoming County, N. Y., storage fields. FPC authorized development of another new storage field, and enlargement of an old one.

Kansas Nebraska Natural Gas Company has asked FPC permission to expand the capacity of its system to 146 Mmcf by replacing 9 miles of 4-inch in the Goodland, Kansas, area with 6- and 8-inch; replacing 22 miles of 6-inch near North Platte, Neb., with 8-inch; replacing 16 miles of 8-inch south of Colby, Kansas, with 12-inch; looping a line running southwest from Palco, Kansas, with 6 miles of 12-inch; installing 1640 hp in existing stations.

Lion Oil Company plans a 70-mile gathering system in Diamond field and Sharon Ridge field, Scurry County, Texas, and a compressor plant to deliver the gas to Lone Star Gas Company.

Lone Star Gas Company has applied to FPC for authorization to build 57 miles of pipe line from its present system to Idabel, Broken Bow, and Antlers, Okla. Company plans distribution systems in these communities.

Michigan Gas Storage Company plans a 50-mile, 22-inch line from Saint Johns to Mount Pleasant, Mich. E. J. Mahoney Contracting Company, Mount Pleasant, will start August 1.

Mississippi River Fuel Corporation has filed a second amended application with FPC for permission to install 28,380 hp in 7 new compressor stations, and an additional 4100 hp in 2 authorized stations. The new stations would be built by another party and leased to Mississippi. In addition, the firm would build a 40-mile, 20-inch line from Dubach to its Perryville, La., station, and a Mississippi River crossing in metropolitan St. Louis.

New York State Natural Gas Corporation has applied to FPC for permission to construct 70 miles of 20-inch from Oakford, Penn., to East Ohio's facilities in Ohio. This line is in connection with an underground storage project in Oakford Storage Area, Westmoreland County, to be undertaken jointly with Texas Eastern if cleared by FPC. Companies propose to develop a storage capacity of 105 billion cubic feet which could be withdrawn at the rate of 400 Mmcf per day, to be divided squally between the two companies.

Ohio Fuel Gas Company has asked FPC authorization for 22 miles of 16-inch in the vicinity of Dayton, Ohio.

Public Service Company of North Carolina has filed an application to construct a distribution system carrying gas to 39 cities and communities in North and South Carolina. System will consist of 365 miles of line connecting with Transcontinental's main line at 10 points. Carolina Natural has a similar application pending.

Southern Natural Gas Company has been authorized by FPC to build 275 miles of 18-inch from Gwinville, Miss., to Marvyn, Ala.; 221 miles of 16-inch from Marvyn to Aiken, S. C.; and 311 miles of loops and connecting lines in Texas, Louisiana, Mississippi, Georgia, and South Carolina.

Tennessee Natural Gas Lines, Inc., has an application before FPC for the construction of a 24-mile line to supply gas to Nashville Gas & Heating Company for distribution in the Nashville area.

Tennessee Natural Gas Lines, Inc., has applied to FPC for permission to build 9 miles of 10-inch connecting its lines to TGT's system.

Texas Eastern Transmission Corporation has asked FPC in an amended application for a permit to construct a 791-mile, 30-inch line from Kosciusko, Miss., to a connection with its system near Connellsville, Penn. The project includes installation of 46,400 hp in 7 stations on the new line, and 52,500 hp in 6 new stations on the existing line. Texas Eastern will supply Algonquin Gas Transmission Company with 260 Mmcf per day at a connection near Lambertville, N. J., for resale in New England. The new facilities, estimated to cost $117 million, will bring Texas Eastern's total capacity to 1216 Mmcf.

Texas Eastern Transmission Corporation has asked FPC permission to build a 35-mile, 30-inch line from its system in Fayette County, Penn., to the Oakford storage area, and to operate jointly with New York State Natural an underground storage project in Westmoreland County, N. Y. (See New York State Natural Gas Corporation).

Texas Eastern Transmission Corporation has been given a permit to build 10 miles of 10-inch from its system to Arkansas-Missouri Power Company's plant in Dunklin County, Mo.

Transcontinental Gas Pipe Line Company has applied to FPC for permission to build 11 miles of 20- and 26-inch from its main line near East Carteret, N. J., to the Bay Ridge section of Brooklyn. Line would constitute an auxiliary connection for the delivery of gas to metropolitan New York.

United Natural Gas Company has asked FPC permission to construct 21 miles of 6-, 8-, and 12-inch line in Venango, Perry, and Mercer counties, Penn. Project also includes the addition of 150 hp. in 3 units at Henderson, Venango County, station.

Utah Natural Gas Company has made application to Utah public service commission to construct 325 miles of 22-inch from the "Four Corners" area in southwestern Utah to the Salt Lake City region. Estimated cost of the project is $25 million.

West Texas Gas Company has application before FPC for permission to

build 19 miles of 10-inch from its 10-inch line northwest of Lubbock to Anton, Texas. The line would replace an existing 6-inch line and is a continuation of an expansion program on West Texas' Lubbock-Farwell lateral.

Projects Starting

Crude Oil Lines

Imperial Pipe Line Company, Ltd., is building 10 miles of 8-inch from Woodbend field to Ellerslie, Alberta, Canada, and an unspecified amount of gathering line in the system. Williams Bros. Corporation (Canada) Ltd., Edmonton, Alberta, started work in May.

Lakehead Pipe Line Company started in June its 360-mile, 18-inch line from Gretna, Manitoba, Canada, to Superior, Wis. Anderson Bros. Corporation, Houston, has the contract. This is the final section of the 1150-mile line from Edmonton, Alberta, to Superior. The first two sections are being built by Interprovincial Pipe Line Company, Ltd.

Montreal Pipe Line Company is at work on 70 miles of 18-inch between Highwater to Montreal, Quebec, Canada. Fred Mannix & Company, Ltd., Calgary, Alberta, started in May. This is the Canadian Section of the 154-mile line from Portland, Maine, to Montreal. Portland Pipe Line Corporation is building the remainder.

Products Lines

Great Lakes Pipe Line Company has started a 165-mile, 12-inch line from Irvington, Neb., to Sioux Falls, S. D. Trojan Construction Company, Oklahoma City, started 47 miles between Irvington and Decatur, Neb., in June.

Natural Gas Lines

Barnsdall Oil Company is building 100 miles of 2- through 8-inch gathering system near Snyder, Scurry County, Texas. C. O. Holder Construction Company, Columbus, Texas, contractor.

Chicago District Pipeline Company started in June a 41-mile, 24-inch loop on its Calumet line from Joliet Township, Wills County, Ill., to Chicago south city limits. Contracting & Material Company, Evanston, Ill., contractor.

City of Dyersburg is building 100 miles of transmission and distribution line in the vicinity of Dyersburg, Tenn. Carruth Pipeline Corporation, Baton Rouge, started work in June.

Deep South Gas Company is building a 12-mile, 4-inch gathering system between Rosedale and Irwinville, La., Carruth Pipeline Corporation, contractor.

El Paso Natural Gas Company started in June 116 miles of 12-inch between Snyder and Goldsmith, Texas, and 42 miles of 30-inch in the vicinity of Van Horn, Texas. Company crews are doing the work.

Gaylord Container Corporation is building 26 miles of 8-inch from Baxterville field to its plant at Bogalusa, La. Carruth Pipeline Corporation, is the contractor.

Hugoton Production Company is building 14 miles of 4- to 10-inch line in Hugoton field, Kansas. Reese Bros. Construction Company, Hugoton, started in May.

Northern Natural Gas Company started in June 114 miles of 26-inch loop between Holmes, Iowa, and Farmington, Minn. R. B. Potashnick, Cape Girardeau, Mo., contractor.

Panhandle Eastern Pipe Line Company is to start work the beginning of July on 160 miles of loop line between its Tuscola, Ill., station and Detroit. Program includes the addition of 16,000 hp to existing stations. New facilities will cost $15,944,500, and are to be completed by October, 1951.

Roanoke Pipe Line Company is at work on 30 miles of 8-inch from Virginia Gas Transmission's line at Gala to Roanoke, Va. Lehman, Hoge & Scott, Corpus Christi, started in June.

Transcontinental Gas Pipe Line Corporation started in June 74 miles of 30-inch from Falls Church, Va., to Conowingo, Md. Associated Pipe Line Contractors, Inc., Houston, contractor.

Transcontinental Gas Pipe Line Corporation started work the end of May on 50 miles of 18- and 20-inch from north of Eunice to a point 15 miles south of Crowley, La. Texas-Southern Contracting Company, Fort Worth, contractor.

Projects Completed

Crude Oil Lines

Humble Pipe Line Company completed in early June a 371-mile, 18-inch line from Kemper to Satsuma, Texas. Morrison Construction Company, Inc., Austin, built 178 miles from Kemper to Eckart, and Anderson Bros. Corporation, Houston, built the remaining 193 miles.

Mid-Valley Pipeline Company completed in June 41 miles of 20-inch from the Red River near Benton to Haynesville, La. Latex Construction Company, Houston, contractor.

Products Lines

Great Lakes Pipe Line Company completed in June 142 miles of 12-inch from Atchison, Kansas, to Omaha, Neb. Midwestern Constructors, Inc., Tulsa, contractor.

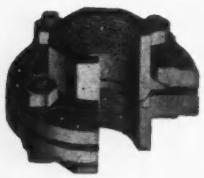
Natural Gas Lines

Arkansas-Louisiana Gas Company completed in June 91 miles of 20-inch from Magnolia to Malvern, Ark. Latex Construction Company, Houston, contractor.

Harrisburg Gas Company completed early in June a 20-mile line from Transcontinental's system at Maytown to Harrisburg's manufactured gas plant at Steelton, Penn. Northeastern Construction Company, Harrisburg, Penn., contractor.

Transcontinental Gas Pipe Line Corporation completed in May a 6-mile, 4-inch gathering line from Vinton to Starke, La. Latex Construction Company, Houston, contractor.

Jefferson Malleable Unions



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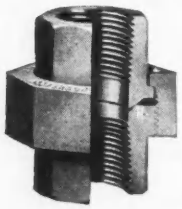

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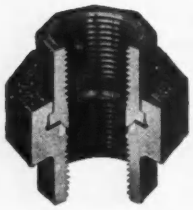

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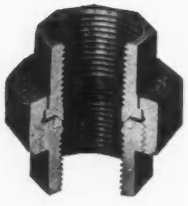

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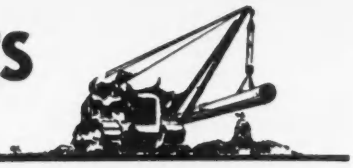

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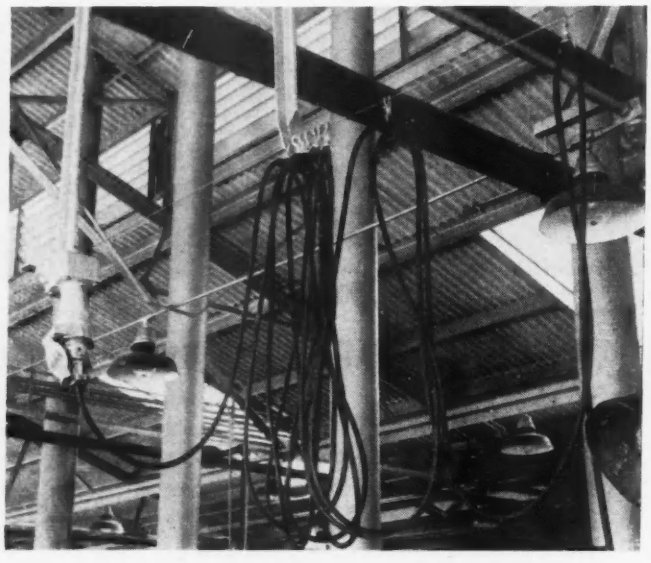
HOW TO—Handle Overhead Extension Cord

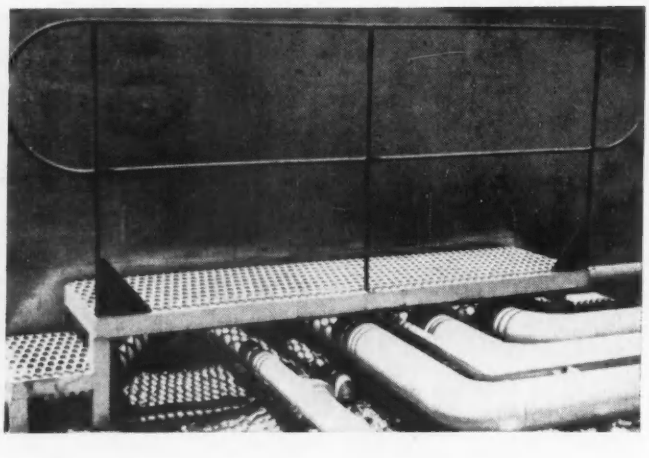


The wide use made of heavy-duty extension cord around a station brought about this method of handling the cord. Since the line is heavy and large due to the explosion-proof construction, it formed a stumbling hazard when strung out on the concrete floor. This idea not only keeps the cord off the floor, but makes it easy to extend the cord in either direction from the overhead electrical outlet.

The outlet drop is located at the most central point along a line of compressors. It is of the explosion-proof type and supports the end of the extension cord, which is equipped with swivel snaps at about 15-foot intervals. The cord is simply threaded through the eyes of the swivel snaps which hook onto an overhead steel line stretched tightly across the battery of compressors. This line is supported from the ceiling structure by angle iron as shown.

When a light is needed to inspect or repair one of the compressors, the extension cord is stretched out along the steel cable until the end of the cord reaches that particular point. In the event the cord is needed across the aisle down the station house, several of the snaps may be removed from the stretched line, and the cord released. The steel supporting line extends down the battery of compressors in both directions so that the cord may be removed from one side and transferred to the other side without unplugging it or getting another cord. The rubber-coated conductors are supported above normal head level so as to be entirely out of the way of normal operations.

HOW TO—Make Movable Line-Crossing Stile



A movable stile with a safety hand rail for the convenience of men working around the pipe lines and tanks is made with an angle iron frame having tread riser supports fitted with flat steel pads to rest upon the ground or paved area. The treads and walk are made of light but substantial open work grating to prevent soil and dirt from accumulating. The hand rail is made of steel rod, either 5/8- or 3/4-inch, shaped for convenience and appearance.

Three vertical risers welded to the frame of the stile are of sufficient length to place the top rail at a convenient point for grasping easily with one hand. The top rail is bent smoothly at each end as a semicircle and welded securely to the 3 vertical risers. Since the only contact between the vertical risers and the outside frame of the stile is at the point where the three are welded, this joint is somewhat weak, and is strengthened by inserting tank steel gussets on the inside of each end post.

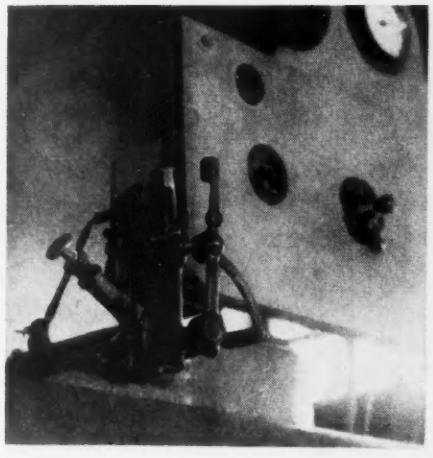
Two men can easily move the stile when the pipe lines require repair, painting or recovering, and at the same time provides a crossing with adequate strength. The steel gussets supply the necessary stiffness without adding materially to the weight of the unit.

HOW TO—

Install Positive Ignition Controls

If a large gas engine is equipped with manual spark control, sometimes a man may turn on the ignition switch and push the starter button without thinking to retard the magneto breaker box. Nine times out of 10 the engine will kick back and may break the starter mechanism. To prevent this, a positive circuit breaker can easily be installed to prevent starting except when the manual spark control is in full retard position.

On certain types of industrial engines, the throttle and spark control quadrants



are installed on a cross shaft just above the carburetor and beside the panel containing the switches, indicators and starting button. The starting button circuit breaker is installed on the back of the control panel and consists of a heavy-duty knife switch set into one of the cables from the battery to the starting switch. A boss is welded to the cross shaft of the spark control lever with holes to connect a rod leading to the knife switch behind the control panel. The adjustment is made so that, when the spark lever is in full retard, the circuit breaker knife switch is fully engaged. If, however, the spark control lever is pulled to one-third advance, the knife switch is pulled out and the connection is broken to prevent starting the engine with the starter button. With this arrangement, an experienced gas engine man will stand with one hand on the button and the other on the spark and throttle quadrant levers so that, when the engine "takes," he can immediately advance the spark and set the throttle.

Instant Full-Open Relief of Excessive Pressures

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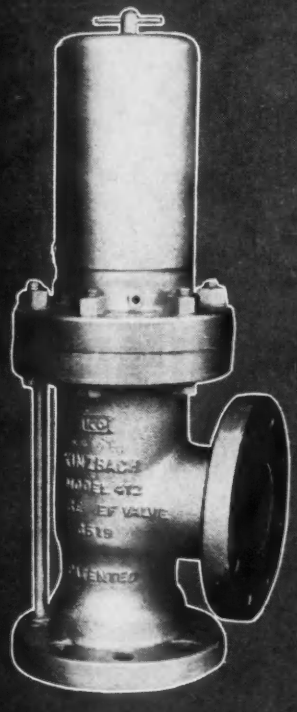

Among the design features that have brought about the immediate acceptance of the Model 412 Valve with pipeline and refinery engineers everywhere is its ability to open instantaneously to full capacity when the pressure overload in the line is reached, thus providing maximum relief when it's most needed.

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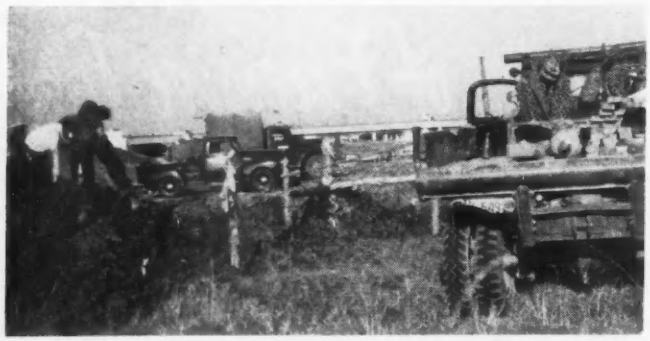
HOW TO—Use Truck Winch to Backfill Small Lines



Small pipe line jobs in many instances do not justify moving in a cat and side boom for covering up the ditch when the line is finished. Here is an idea that saves the use of an expensive tractor on small jobs and yet performs the job very well.

The crew truck is always nearby when the lines are connected up, and one pipe liner uses the crew and tool truck to power the mormon board in backfilling small pipe lines.

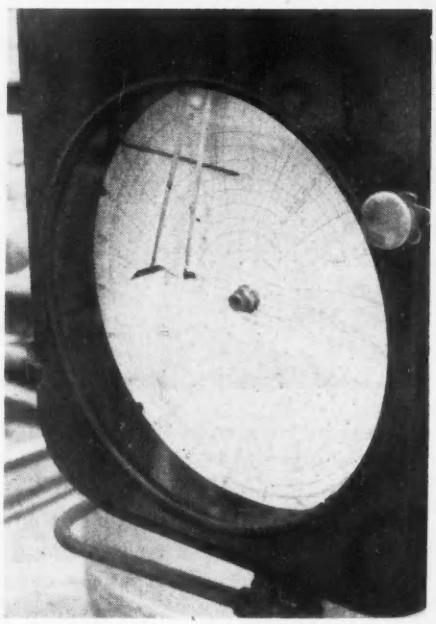
A block is hooked to the top of the headache post behind the cab and the winch line run through it and connected to the mormon board. The truck is then run along side the pipe line and the winch is used to drag the dirt back into the ditch or bell hole.

The driver is able to sit in his usual position and watch the progress of the work through the open door of the cab. The brake is kept free on the winch so that the line feeds off easily and the board can be pulled back to obtain a new bite.

Where pipe lines are being backfilled, the truck moves along the line as the dirt is pulled back into place. On bell holes, the truck is maneuvered around the hole so that the dirt can be heaped directly over the hole.

HOW TO— Increase Capacity Of Recording Pens

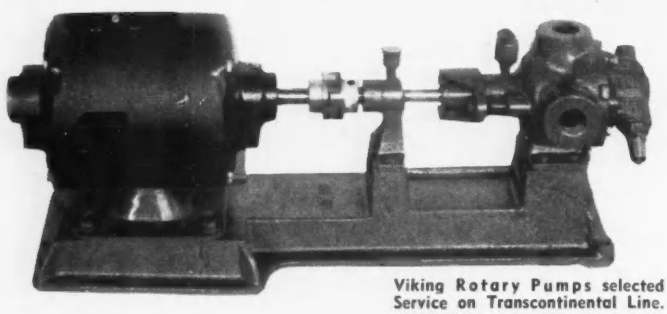
Where differential pressure varies from minute to minute, the red ink supply must be augmented by additional capacity of the inking pen. A novel and simple means of holding more ink in the red pen was devised by a lease man. He used two additional static pen points with open backs, and replaced the differential pen point with an open-backed point.



Using a small pair of pliers, he fitted the points into each other so that all three points could be used to hold ink, thus providing triple the capacity. After cleaning the points thoroughly, 3 times the usual volume of ink was placed in the set of points and it was necessary to re-ink the pens only when the chart was changed.

This added reservoir space is indispensable when wells are on gas lift as the differential pen is usually "painting" a wide mark around the chart. By tilting the points upward at the correct angle, the ink will not run out at one time, and a full chart record is obtained.

Dependable POWER for PUMPING



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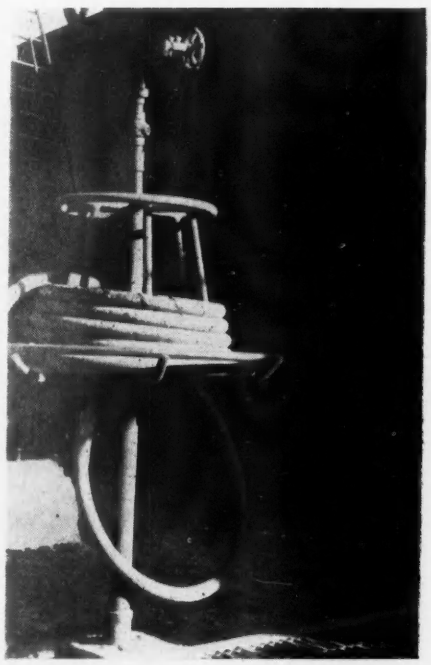
HOW TO—Construct Convenient Reel for Fire Hose



It is essential that fire-fighting equipment be placed strategically around any pumping or booster station to combat small fires that could easily spread into large ones. In addition to chemical extinguishers, it is desirable to place water hoses at several points on the station grounds. These hoses are several hundred feet long and are of such a size that one man can handle them if necessary.

Here is a handy hose reel that provides a maximum of utility in fighting fires. Principal advantage is that little resistance is offered when firemen uncoil the hose from the reel. The hose feeds off rapidly and does not kink.

Water supply is from an overhead pipe which extends from an adjacent building. The reel is welded to an upright piece of 2½-inch pipe connected at the upper end to a swivel joint. The lower end of the vertical piece is capped and placed inside a nipple of 3-inch which serves as a bearing for the rotating riser. The 3-inch nipple is set in a small concrete foundation to steady the reel when the hose is pulled off.

A welded tap on the vertical member is connected to the rubber hose with a union to supply water through the vertical riser and into the hose, even though the vertical member is rotating in the swivel joint. Hose is coiled around a framework of rod steel welded to the rotating center pipe. The lower end of the reel is basket-shaped to support the hose as it is coiled up. The reel holds several hundred feet of small-diameter rubber hose, and since the entire reel rotates, the hose can be pulled out in a hurry by one man. Water supply is controlled by the gate valve in the riser and by a valve in the nozzle of the hose.

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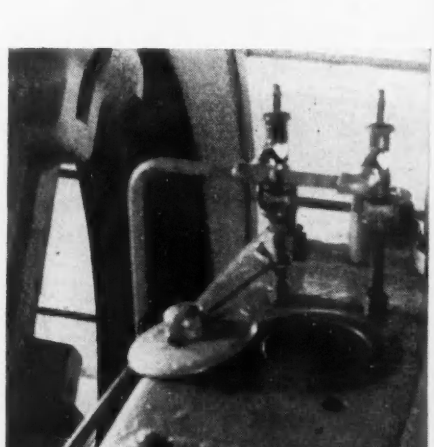
HOW TO—Secure Main Bearing Cap

On several models of large engines there is a round breather cap that permits inspection and filling of oil in the lubricating chamber adjacent to the flywheel. Experience has shown that the disconnected cap can easily slip from the engineer's hand and fall into the nearby flywheel. To recover the cap, the engine must be stopped. It is possible that the engineer may instinctively grab for the cap and be injured by the flywheel.

The cap can be satisfactorily anchored to the engine so that it may be moved freely without danger of dropping. The anchoring device consists of a short section of welding rod which passes through a small hole drilled in the knob on the cover and welded in place. The other end is bent around a half-inch lubricating line near the opening to the main bearing. When the engineer wants to look into the housing, the cap is



merely shoved to one side without taking hold of it. The welding rod also keeps the cap from vibrating out of place.

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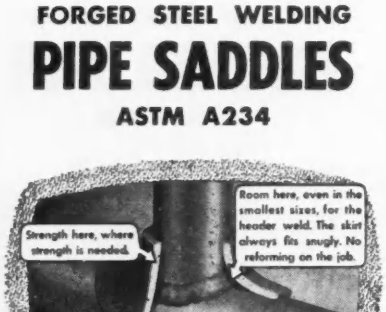
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Drilling Mud Problems in Western Canada

AS EXPLORATORY drilling increases in Canada the use of drilling muds has advanced from a hit and miss proposition to a systemized technique of application. The writers present an authoritative report on mud conditioning procedures generally accepted as standard in Canada today.

By

E. C. BUFFINGTON
District Superintendent,
Calgary, Alberta, Canada

and

V. V. HORNER
Field Service Engineer
Mid-Continent Division, Tulsa
Baroid Sales Division, The National Lead Company

THE drilling muds used in Western Canada, and their treatments, are as varied in character as are the operating conditions under which the widespread development program is being carried out in Alberta today.

The ever expanding exploration and leasing effort has already covered most of Alberta along with parts of Saskatchewan and British Columbia. Most of the recent increase in drilling activity, which began with the Leduc discovery near Edmonton in 1947, has been confined to the province of Alberta. Such names as Pincher Creek, Stettler, Woodbend, Redwater and Normandville represent oil finds extending from near the U. S. border to the Peace River country, 520 air miles to the northwest, and 250 miles eastward into the plains from the Rocky Mountain front. In addition to development of proven acreage, wildcat drilling activity within this expanding area continues to add to the magnitude of the Canadian oil enterprise.

A few steam rigs are in operation; however, most of the rigs are of the compounded mechanical type. Several heavy duty rigs are used to drill the 10,000 to 12,000-foot mountain foothill tests, but most operations are at shallower depths and are being drilled by rigs in the 6000 to 7500-foot class. During cold weather, rig layouts include a boiler installation to generate steam for protecting and blowing mud and water lines. Rigs are boxed in, including the circulating system, when low temperatures prevail.

Multiple-pit surface systems of 300 to 400-barrel capacity are in use, but the settling ditch, single suction pit systems are in the majority. Settling ditch design varies from rig to rig, but two general types are in common use. One type utilizes a single wooden trough, 24 inches wide and 12 inches deep, running from the shale shaker at the well discharge to the suction pit at the rear, or pump end, of the rig. The main trough is usually fitted with an end gate for cleaning and with a stepped up ditch angling into the suction pit. The end gate is a straight pullup type fitted into vertical slots or guides. Frequently, these end gates are made of plate steel to form a hollow inner chamber fitted with a steam connection. In this way the gate, when frozen into place, can be thawed for immediate withdrawal. The ditch is easily cleaned through the end gate with a wooden scraper.

A more recent design, and one which is gaining in popularity, is a rectangular return-bend trough unit. This portable unit, usually mounted on skids, is 8 to 10 feet wide, 18 to 24 feet long and is partitioned into from 3 to 5 parallel flow ditches. Mud flows into the first section its full length, then returns along the parallel companion section. This flow pattern is extended through the several parallel sections with the mud discharging from the last section into the suction pit. The unit is placed between the shale shaker and suction pit and is provided with short extension ditches from the inlet and discharge ends to the shale shaker and suction pit respectively.

The slope of the ditch floor is gradual and provides shallow mud flow along its course. The ditches are efficient in settling fine solids and sand from the mud and, consequently, reduce the mud pit volume requirements.

A typical boarded suction pit is approximately 8 x 8 x 6 feet. Most suction pits do not have a partition; however, some of the larger pits (12 to 15 feet long) have one partition placed about mid-length of the pit to provide additional settling space.

Within the recent development area of Central Alberta, drilling depths vary

from the 2000-foot Cretaceous tests along the Alberta-Saskatchewan boundary to the 12,000-foot Madison limestone objectives in the mountain foothills. Devonian limestone drilling, which has resulted in the majority of recent oil finds, varies in depth from nearly 7000 feet in the Peace River country to 3300 feet at Redwater. Productive Devonian is found between 5000 and 5300 feet at Leduc.

Up to now, Alberta has not been considered a "weighted mud country," although weighting material has been used in special cases. A few foothill tests have employed 10.5 to 11.0 pounds per gallon muds, but such weights are not considered in the class of heavy muds. The few blowouts experienced have been associated with lost circulation trouble where, due to the reduced hydrostatic pressure, a shallow gas sand blows out, or where gas cutting of natural weight muds was not properly controlled. The famous Atlantic 3 blowout and fire at Leduc in 1948 were associated with lost circulation difficulties. The reduction in hydrostatic pressure, which allows these blowouts, is caused by the mud column dropping in the hole when circulation is lost.

Drilling depths are greater in the foothill section but extensive mud treatment is not required and mud costs are not high. Bentonite, fresh-water muds are used to drill the long Upper and Lower Cretaceous and Madison shales and sandy shales. Any hole trouble encountered in drilling these hard, steeply dipping, long shale sections can usually be corrected by minor mud treatment, proper weight on the bit and good drilling technique. The native muds have good filter loss characteristics when maintained with water and bentonite additions along with light chemical thinner treatments (caustic soda and quebracho). These materials are added to the native mud in quantities sufficient to give concentrations of from 15 to 18 pounds of bentonite, and from 0.25 to 0.50 pounds each of caustic soda and quebracho per barrel of mud. The treated muds should have the following physical characteristics: weight, 10 to 10.5 pounds per gallon; viscosity, 40 to 45 seconds (API funnel); gel strengths, low; filtrate losses, below 10 cubic centimeters API. These characteristics have been found generally satisfactory for drilling the Madison tests.

Eastward from the southern and central foothill region the Devonian is the drilling objective. Lost circulation along with anhydrite and salt contamination increase mud treating costs. The Upper and Lower Cretaceous shales are drilled with little mud expense. Devonian drilling mud costs increase depending upon the amount of salt and anhydrite contamination and the severity of lost circulation.

Where 60 to 120 feet of Devonian anhydrite are encountered, such as at Leduc, barium carbonate is the best treating chemical because it precipitates both the calcium and sulfate contamination. Since barium carbonate does not affect the viscosity or gel strengths of a mud free from calcium sulfate contamination, the chemical is frequently added to the drilling mud before penetrating the anhydrite, thus preventing any contamination of the mud. A solution of caustic soda and quebracho (equal parts of each chemical) is used as a thinner along with the barium carbonate to assist in controlling the viscosity and gels of the drilling mud. The combined use of the chemical thinner and the barium carbonate controls the flow characteristics of the mud and prevents a filter loss increase. Filter losses should be maintained within the 10- to 15-cc range.

Soda ash (sodium carbonate) may be used where small amounts of anhydrite are encountered. However, the formation of sodium sulfate in the reaction of sodium carbonate with calcium sulfate limits its practical use. Increasing amounts of sodium sulfate have a detrimental effect upon the drilling fluid, resulting in increasing filter losses and gel strengths. Although the sodium sulfate concentration may be reduced by fresh water dilution, which in turn requires bentonite addition, the economics of such a treating method invites consideration.

The complex phosphates have been used in treating anhydrite, and on occasions have been used in combination with soda ash. Although they serve as a mud thinner as well as for precipitating the calcium ion, they offer the same disadvantage as soda ash in that sodium sulfate is left in solution, and the calcium is precipitated as calcium phosphate.

Soda ash, in small amounts, has been used in conjunction with barium carbonate for treating anhydrite contaminated muds. However, to avoid a sodium sulfate buildup the amount of soda ash is limited to approximately 1 pound per barrel of mud and the treatment is completed with barium carbonate.

As Devonian drilling moves eastward into the central plains of Alberta, such as at Stettler, massive anhydrite sections below the Lower Cretaceous approach 400 to 600 feet in thickness. Often, but not in every case, a salt section underlies the massive anhydrite. With such massive anhydrite sections and the possibility of salt below the anhydrite, chemical treatment to precipitate the calcium sulfate contamination is impractical from a cost standpoint. A more practical method is the preparation of a base mud whose viscosity, gel strength and filter loss will remain stable when heavily contaminated with calcium sulfate and salt. One means of accomplishing this is to saturate the base mud with controlled additions of calcium sulfate, after which

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A portable rig operating on Graham Island, British Columbia, shows the general terrain of wildcat territory. Steel mud tanks, now popular in Canada, are left of the motors in the photograph.

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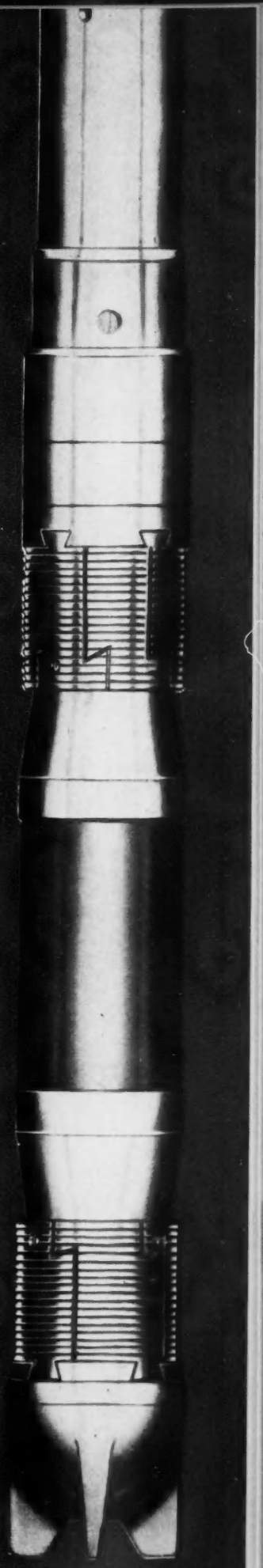

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Small settling tank leading from shaleshaker and small suction pit to the right in photo indicate low volume mud systems now used in Canada.

H. Pollard, Calgary, Alberta

A winterized rig in Western Canada, showing derrick floor, motors, pumps, and mud system completely protected from the severe weather.

starch and an organic preservative are added.

Such muds are used in drilling these massive anhydrite sections in Central Alberta. At a depth slightly above the massive anhydrite, controlled additions of plaster of Paris ($CaSO_4 \cdot 1/2\ H_2O$), along with any necessary water dilution, are made while drilling proceeds. Sufficient water is added to control the viscosity. Upon saturation of the mud with calcium sulfate (1½ to 2 pounds per barrel of mud), indicated by an equalizing of the initial and 10-minute gel strengths, a modified starch and an organic preservative are added to reduce the filter loss. When the massive anhydrite is penetrated, or if any salt is drilled, the mud properties remain stable. This type of mud is characterized by its flat gel strengths which will range, depending upon the viscosity, from 10-10 grams to 40-40 grams Stormer. Viscosities are usually maintained in the 38 to 42-second Marsh Funnel range to keep the gel strengths from becoming excessive. Maintenance is simplified by the inherent stability of the mud and its resistance to an unlimited amount of anhydrite and salt contamination. Water and bentonite or salt-water clay are used for viscosity and solid-content control. Modified starch is used for filter loss control. A preservative is used to prevent the starch from fermenting. This controlled calcium sulfate treatment allows continued drilling without any shut down and without the dangers associated with the excessive viscosities which would occur if the anhydrite were penetrated with the fresh-water bentonite mud.

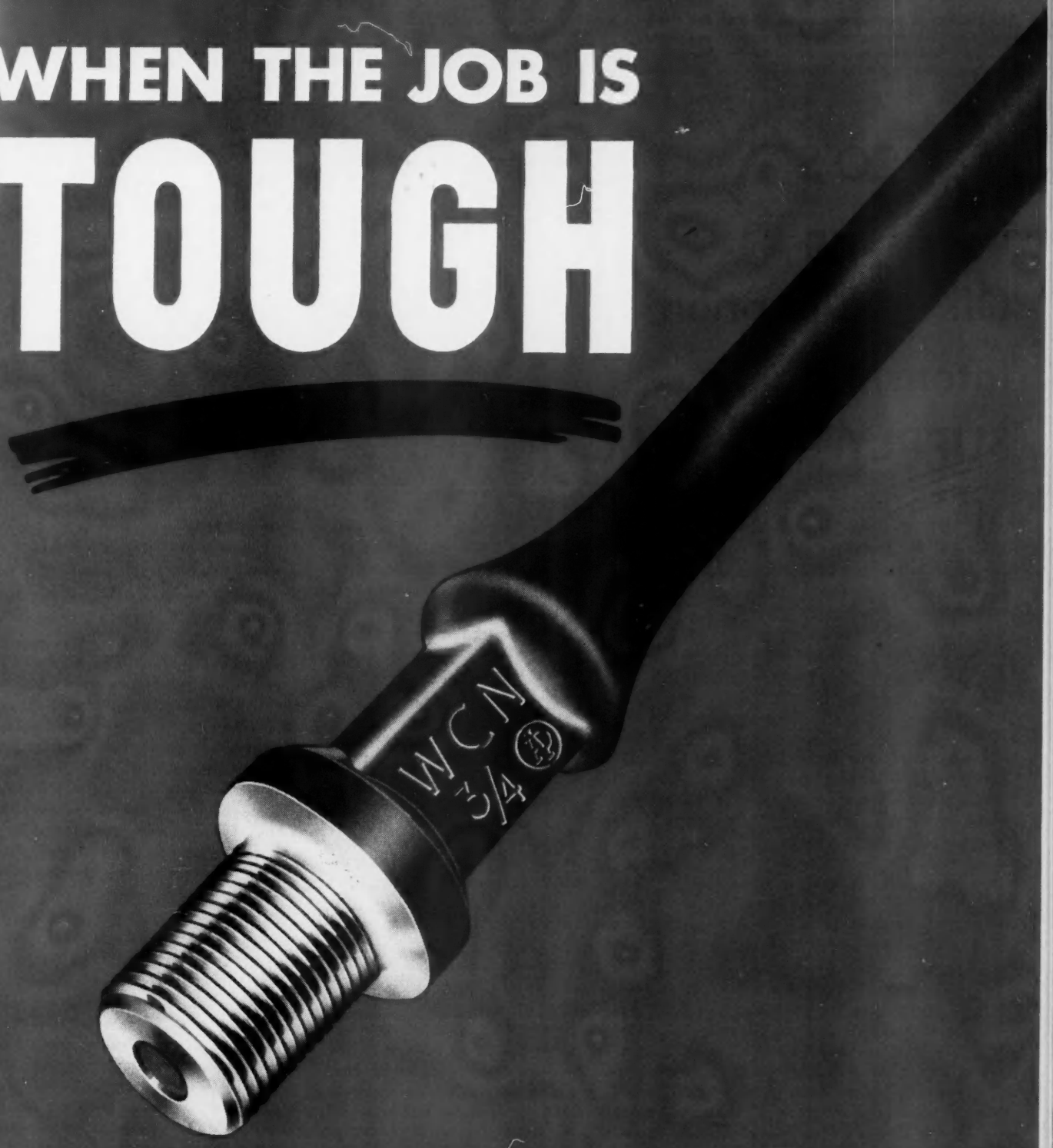
Lost circulation is of particular concern wherever the Devonian is drilled in Alberta. When mud loss occurs the severity may vary from partial to total loss of returns. Wildcat wells drilled in the east-central plains area have not experienced severe circulation losses in the Devonian. However, fields like Leduc indicate that wherever the Devonian is drilled the possibility of severe circulation losses should not be overlooked.

The small circulation system is not considered a disadvantage in combating lost circulation. The "spotting" method is in common use and consists of spotting a few barrels of mud, heavily loaded with lost circulation material, on bottom through the drill pipe. This is followed by filling the annulus with mud to the surface, if possible, thus effecting a mild form of squeeze on the spotted mud. One or more such applications serve to cure or evaluate the severity of the leak. If this method proves unsuccessful cementing is tried. Where circulation loss occurs in productive sections and cementing is not desirable, mud heavily loaded with lost circulation material is spotted at the leak with cementing truck equipment. In this way a much heavier concentration of lost circulation material can be spotted than could be pumped with the conventional rig slush pump. The greater the amount of lost circulation material available to plug the thief formation the greater the chance of success.

The danger of a blowout from the shallower gas sands at Leduc, resulting from loss of circulation in the productive, vuggy Devonian D-3 zone, has been reduced by setting a long string of 7-inch casing at the base of the green shale section immediately above the pay and completing the well through a 5-inch liner.

The crooked holes and long shale sections of the foothills, the anhydrite and salt drilling of the plains, and the lost circulation hazard of the Devonian cause great variation in drilling mud design treatment and cost. Except for heavily weighted mud, all other types are represented in Western Canadian drilling. As development is extended in this vast area, mud programs and techniques will be extended to meet the new requirements. Wildcat drilling undoubtedly will bring out new problems which will require the development of different mud programs and treating techniques.

WHEN THE JOB IS TOUGH



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The problem of transporting crude oil from the thinly populated Gulf producing areas to heavily populated mountain tablelands is emphasized by the location of this pipe line pumping station atop a mountain.

MEXICO'S Increasing Oil Consumption Intensifies SUPPLY PROBLEMS

MEXICO'S oil requirements have grown at 2½ times the rate of those of the U. S. in the last 12 years, Petroleos Mexicanos, the Mexican petroleum administration, reported in May.

Pemex said Mexican domestic consumption rose to 44.6 million barrels in 1949, an increase of 205 percent over 1937. U. S. demand, reaching 2.1 billion barrels in 1949, represented an increase of 80 percent for the same period.

The greater rate of increase for the smaller nation reflects the rapid industrial and agricultural development taking place in Mexico, according to Senator Antonio J. Bermudez, director general of Pemex. He said:

"The oil industry has contributed importantly to the industrial development achieved in Mexico and gives major support to the expansion of agricultural activities, particularly in connection with the vast irrigation program which the federal government is developing.

"The phenomenal rate of increase of domestic demand has placed a heavy strain on supply and distribution facilities, causing occasional shortages in some areas of the country. In addition, there have always existed the enormous difficulties in transport, due to the topographical extremes between the oil producing zones and the zones of principal consumption.

"But consistent progress is being made in supplying the national market. Last year Pemex distributed a 12 percent greater volume of oil products than in 1948 and a 21 percent greater volume than in 1947.

"Projects to be completed this year, including new refineries and pipe lines, promise a satisfactory correction of current problems of distribution by 1951.

"Of the greatest immediate benefit will be the new Pemex refinery soon to be completed at Salamanca and the 280-mile pipe line which will supply it from the Poza Rica field. The Salamanca refinery will add 30,000 barrels a day to the nation's supply of oil products. But, even more important, it will provide this new supply in the region where consumption is greatest.

"While the new installation will raise the refining capacity for the country as a whole by 17 percent, its key significance lies in the fact that it will step up refinery output in the high central zone, where principal domestic demand is centered, by 60 percent."

Salamanca, 180 miles northwest of Mexico City in the state of Guanajuato, is at an elevation of 5600 feet, or slightly higher than Denver. Its supplying pipe line starts at sea level and reaches an elevation of 8700 feet in getting over the hump of the Sierra Madre Oriental.

The high central zone which the Salamanca refinery will help serve is boxed in by mountains. Two thirds of the Mexican people live in this tableland area and it represents 58 percent of the nation's total oil requirements. In contrast, only 31.6 percent of the national demand is in the Gulf of Mexico's low coastal zone where the oil is produced, and 10.4 percent is on the Pacific Coast.

In the past, the sole direct supply of refined products for the high zone has come from the Atzcapotzalco refinery at Mexico City, which has a capacity of 50,000 barrels per working day.

Supplementing the Mexico City refinery, the Salamanca plant will bring refinery output for the high central zone up to 80,000 barrels per working day, an increase of 60 percent. It will bring the total installed refining capacity of the country up to 210,000 barrels per working day, an increase of 17 percent.

In the first 4 months of 1950 Mexico exported 7,095,544 barrels of crude oil and light products for a daily average of about 59,200 barrels. This is a considerable increase over the daily average export for 1949 of 37,209 barrels. The bulk of the exports, about 5/7 of the total, still goes to the U. S.

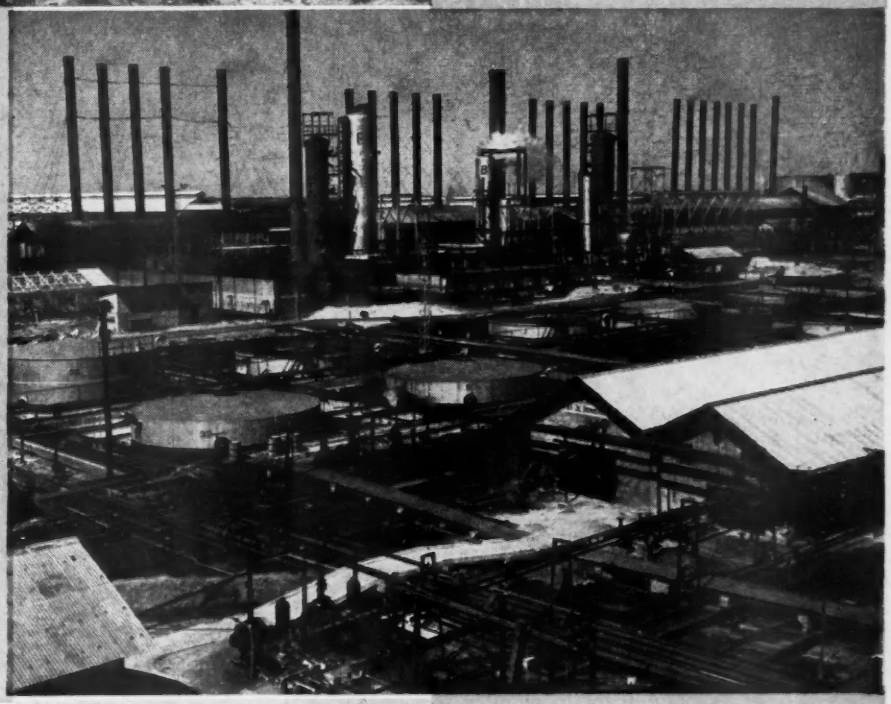
Crude oil production in Mexico averaged 166,400 barrels daily in 1949. The daily average for January of this year was 183,398 barrels, and for February, 187,779 barrels, according to the latest information from Pemex. This increase in daily output is attributed to the completion of 58 new oil wells in December, 60 in January, and 65 in February. Most of the new producers were found in the southern region in the Moralillo and Alazan fields with the Isthmus area running a close second.

Mexico's plans call for the drilling of more than 300 wells this year, with a production goal set for 250,000 barrels daily. The country is now undertaking an intense exploratory program. Mexican American Independent Oil Company is presently drilling for Pemex along the Gulf of Mexico, in Vera Cruz and Campeche states, where several large oil strikes have been reported in recent months. In addition to contracted drilling, Pemex is carrying on a drilling program of its own in other areas of the country. The government oil monopoly recently reported a new oil find at Laguna Rosario in Tabasco. However, a spokesman for Pemex indicated that the well has not yet completed drilling. It is hoped that production will be found at a greater depth than the first sections tested.

Mexico's first consideration is to becoming self-sufficient in oil as well as other industries. In many respects the development of Mexico's oil resources is as important to other countries of the Western Hemisphere as it is to the isthmus country itself.

Mexico exports large amounts of crude oil and products from the port of Tampico, chief commercial city of northern Mexico. Tampico stands on the left bank of the busy Panuco River, 7 miles from its mouth at the Gulf of Mexico.

More refineries like this plant at Tampico will be built or enlarged in the next 2 years. Shown is a general view of the distillation units at Madero refinery.



Mexico is seeking new oil reserves in all parts of the country. This well is in the rugged terrain of the Poza Rica region.

Iraq Big-Inch Contract Awarded

Panoramic map of the location of the big-inch pipe line to be built from the Kirkuk oil field in Iraq to Banyas, Syria.

CONTRACT to construct the 32- and 30-inch pipe line from Iraq to Banyas, Syria, was awarded to Arabian Bechtel Company. The completion of the large pipe line, described in the June WORLD OIL, will permit the British operated Kirkuk field in Iraq to produce at full capacity. Along with the 2 smaller pipe lines now in place, the daily throughput after the big line is laid will be in excess of 500,000 barrels of oil from Iraq. This volume will materially replace dollar oil markets in the Mediterranean and Western Europe with sterling oil.

The construction of the pipe line in itself will be of immense interest, both historically and politically. The pipeliners will be working through country which is in the area called the cradle of civilization. They will cross the mighty Tigris River south of Ashur, the first capital of the ancient Assyrians, and north of Tikrit, the birthplace of Saladin, the Kurdish warrior who opposed the Crusaders in the 12th Century. They will cross the Euphrates River north of the town of Hit, from which pitch was dug to build the walls of Babylon. Moving across Syria, they will pass the magnificent ruins of the city of Palmyra, which may have been founded by King Solomon; and nearing the coast they will be among the castles of the Crusaders and on ground where battles were fought and histroy was made a thousand years before Christ.

Much of the pipe line will follow one of the great trade routes of antiquity to Persia from Phoenicia and from Egypt and Arabia, traversing waterless deserts as well as settled and cultivated country. The maximum elevation is 2527 feet. The last 90 miles of the pipe line will be reduced to 26-inch because there is a sharp drop to the sea in that distance which will permit gravity to help move the oil. Two major river crossings will occur at the Tigris and Euphrates, each about 1400 feet wide. The only other crossing of consequence is that of the Orontes River, which is about 100 feet wide. The entire 566-mile line will be buried after having been double coated and double wrapped with glass fiber and rubberized asbestos felt.

Bechtel's base camp will be at Homs, Syria, about 60 miles northeast of Tripoli, near the source of the ancient Orontes River. Field work will be done by teams composed of Americans, British, Syrians and Iraqis. There will be only 44 Americans on the job, about 200 British and the remainder of the workers will be recruited locally. The field force will be headed by Clark Rankin, vice president and project manager for Arabian Bechtel Company.

View of Tripoli, Lebanon, where Arabian Bechtel Company has established administrative headquarters. The city has a population of 40,000, predominantly Moslem.

Accounting and Tax Problems *in Canada*

By ROSS T. WARNER
Warner and Godfrey, Certified Public Accountants, Tulsa

FOR OIL OPERATORS who contemplate entering the Canadian oil play this paper presents a thorough analysis of the tax and accounting problems involved. Outside companies may enter Canadian oil operations through various forms of business corporations or subsidiaries but individual operations are inadvisable. Income tax problems are especially important to groups now engaged in oil activities as well as those with plans for future Canadian operations.

WESTERN Canada has produced oil since 1914. However, it was not until the great Leduc discovery in the Province of Alberta in 1947 that the tremendous potential of that area was recognized. Most of the major American oil companies, as well as many independents, are now operating in Western Canada.

At present there are 12 recognized oil fields, all of which are in Alberta except the Lloydminster which extends from Alberta into Saskatchewan. Present production in all Alberta is approximately 60,000 barrels a day. This is far below the capacity of the wells, due to the lack of distribution facilities. The problems of distribution and refining gradually are being solved, and by the spring of 1951 a pipe line from Edmonton to Superior, Wis., having a daily capacity of 75,000 to 90,000 barrels, is scheduled for completion.

On March 20, 1950, there were 78 rigs drilling in Western Canada. There were 1176 producing wells of which 354 were in the Leduc field, 191 in the Lloydminster field, 264 in the Red Water field, and 279 in Turner Valley. The remainder was scattered among the remaining fields.

This activity and the almost unlimited possibilities have attracted many oil companies, suppliers of oil field equipment, drillers and others whose businesses relate to the production of oil.

These operations, both present and contemplated, give rise to a number of accounting and tax problems. Naturally these problems will differ, depending upon the method adopted for Canadian operations.

Persons may engage in business in Canada as individuals or as partnerships without incorporating. Because of the relatively high individual income taxes and the lack of benefit from limited liability, individual operations are not advised.

Three other methods of carrying on operations in Canada are discussed in the following paragraphs.

A U. S. company can open a branch office in Canada and register as a foreign corporation. In this case the company's original entity is not changed. The operations of the Canadian branch, however, must be maintained in such manner that a profit and loss statement can be prepared showing proper distribution between U. S. and Canadian income and expenses, since the company would be subject to Canadian corporation taxes on its earnings in Canada.

Forming Subsidiary

Another method is the formation of a domestic corporation as a subsidiary company, all of the stock being owned by its U. S. parent company. This subsidiary company would register in Canada as a foreign corporation and its operations would be confined to Canadian business. The head office, the records and directors could all be located in the U. S., where all directors' and stockholders' meetings could be held. This corporation would be taxed in Canada on its net income, and any dividend paid by it to the parent company would not be subject to a further Canadian tax. Since its operations would be completely separate from those of the parent, it probably would be found easier to obtain a proper distribution of income and expenses between the Canadian and the U. S. corporations.

The third method of operation is the formation of a limited company under the laws of one of the provinces of Canada, all of the stock being owned by the U. S. company. While the Canadian subsidiary could be operated from the U. S. it would be required to have a head office in Canada. Dominion or Alberta companies do not require directors to be resident in Canada, but Saskatchewan and British Columbia require at least one director to be a resident in the province. Other than the requirement that each director must also be a shareholder, there are no residence stipulations relating to shareholders. Dominion companies must hold annual meetings, or any meeting electing a director, in Canada. Alberta companies may hold annual meetings in accordance with their terms of articles of association. British Columbia companies must hold all general meetings in that province. Saskatchewan companies must hold all general meetings in that province unless prior permission is obtained from the provincial secretary.

Any dividend paid by a Canadian subsidiary to its U. S. parent company is subject to a tax of 5 percent to be withheld at the time of payment; or if dividends are paid to individuals in the U. S. they are subject to a 15 percent withholding tax. The Canadian subsidiary is subject to Canadian income taxes on its earned income, the same as in the case of domestic subsidiary registered in Canada.

Regardless of the method selected for the Canadian operation, foreign exchange transactions are controlled by the Foreign Exchange Control Board. Before commencing operations in Canada a nonresident should record its plans and purposes with this Board in order that

future transactions may be properly cleared.

An investment can be made in Canada either by purchasing Canadian dollars in the U. S. on the free market or by transmitting U. S. dollars to Canada and there converting them into Canadian dollars at the official rate. At the present time the difference between the official rate and the free market rate is only about ½ percent. Unless proper steps are taken with the Control Board and its orders complied with, a substantial loss could result. Depending upon the circumstances, capital withdrawals, the withdrawal of profits, or the repayment of loans can be made by one of the following methods:

Exchanging Canadian dollars for U. S. dollars in Canada at the official rate, 10½ percent.

Paying with Canadian dollars, which would be exchanged for U. S. dollars on the free market at a discount rate of 11 percent.

Under certain circumstances by the purchase in Canada of certain designated Canadian securities, not including government securities, and which mature in 3 years or more. These securities would then be sold in the U. S. The present discount rate is approximately 14 percent.

There are certain restrictions for the use of Canadian dollars purchased in the U. S. and transmitted in Canada. While they may be used for general operating expenses, the purchase of real estate, oil leases, or property rentals, they cannot be used by a subsidiary Canadian corporation to buy U. S. dollars in Canada to pay for goods imported from the U. S.

In order to pay for materials imported from the U. S. with U. S. dollars, these funds first must be advanced by the U. S. company to its Canadian branch, and if furnished on a loan basis the minimum term required by the Control Board is 3 years. Canadian dollars acquired in the U. S. on the free market and transmitted to Canada, must be returned to the U. S. before U. S. dollars can be purchased in Canada for the payment of debts owed to the parent company.

Profits from a Canadian subsidiary may be withdrawn only in the form of dividends. Application must be made with the Control Board on Form DIV which calls for certain accounting information including the amount of net profit for the year. Such applications must be filed at least 30 days before the proposed date of payment and actual payment may not be made until at least 90 days after the close of the applicant's fiscal year. Ordinarily not more than one year's earnings may be withdrawn in any one year. The profits, while expressed in Canadian dollars, may be converted into U. S. dollars in Canada at the official rate of exchange. The Board may permit the withdrawal of additional profits where new capital is involved, but this probably would be done without conversion privilege in Canada.

Profits from the sale of developed property in Canada, which property was acquired with new money brought in since the inception of the Control Board in 1939, and which was recorded with the Control Board, are permitted to be withdrawn in Canadian dollars by non-residents without conversion privileges in Canada. Such Canadian dollars would then be converted in the U. S. at the 11 percent discount rate. If the capital which was used to purchase the property had entered Canada prior to 1939, the transfer of such profits back to the U. S. could be made only by the purchase of certain Canadian and domestic securities described previously.

Whichever method of operation is adopted, the Canadian income taxes will have to be paid, but these taxes can be used as a credit (subject to certain limitations) against the U. S. federal income tax. There follows a computation of the over-all income taxes, both Canadian and U. S., which would be payable by a domestic subsidiary operating as a Western Hemisphere Trading Corporation as compared with those by a Canadian subsidiary, assuming a *net income* from Canadian operations in Alberta of $100,000.

Western Hemisphere Trading Corporation	
Dominion and Provincial taxes	$35,700.00
U. S. tax on balance of profits paid to parent company as a dividend	3,665.10
TOTAL TAX	39,365.10
Foreign Subsidiary	
Dominion and Provincial taxes including 5 percent withholding tax on dividends	38,915.00
After applying credits for taxes paid to Canada there would be no U. S. income tax	
DIFFERENCE IN TOTAL TAXES	$ 450.10

It will be noted from the foregoing computations that there is little difference in the total income taxes for these types of corporations.

In Canada, income taxes are levied by the Dominion government and the 10 provincial governments, but not by cities, towns or municipalities. All of the provinces, excepting Ontario and Quebec, have a reciprocal agreement with the Dominion whereby provincial taxes are calculated on the same taxable net income computed for purposes of Dominion income tax and the applicable taxes are paid to the Dominion government. The present tax rate in these eight provinces, which include Alberta and Saskatchewan is 5 percent. In Ontario and Quebec the tax rate in 7 percent.

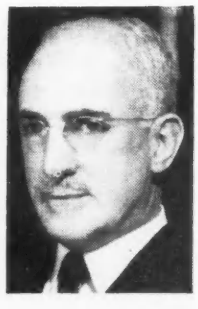
Tax Rates

Effective January 1, 1949, the Dominion tax became 10 percent on the first $10,000 of taxable income and 33 percent on any amount in excess of $10,000. Income taxes must be paid in 12 monthly installments, starting with the seventh month in the company's fiscal year and ending in the sixth month after the end of the fiscal year. In each of the last 6 months of the taxation year the payment required is 1/12 of the estimated tax. In each of the first 5 months after the end of the fiscal year 1/6 of the balance is payable, and the remainder of the tax is payable in the sixth month.

The tax payable is based on the estimated income for the current year, or the income for the year immediately preceding. Tax returns must be filed at the end of the sixth month after the company's year ends. A penalty of 5 percent of the tax will be imposed for delinquent returns. There are interest penalties if the tax is not paid when due.

The determination of Canadian taxable income does not differ in many respects from the method used in determining U. S. federal taxable income. One of the important differences is in

About the Author



ROSS T. WARNER is a partner of the public accounting firm of Warner and Godfrey, Tulsa. He is a former member of council of the American Institute of Accountants, and is now a member of its committee on membership. He is a past president of the Oklahoma Society of Certified Public Accountants. He has taught accounting and taxation for many years at the Oklahoma School of Accountancy, law and Finance.

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Baker
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Safe, Positive Operation Saves Time and Money

Running and setting a Baker Retainer Production Packer, or a Baker Bridge Plug on a wire line provides these important advantages in comparison with running on drill pipe or tubing:

(a) Costly rig time is saved, and wear and tear on tubular goods and rig equipment is eliminated.

(b) There is less likelihood of premature setting.

(c) The use of an electrical conductor cable, equipped with a device to locate collars, insures setting of the Packer or Bridge Plug in the desired section, and not at the joint.

(d) When the well is to be gun-perforated in conjunction with the setting of a Baker Retainer Bridge Plug or a Baker Packer, only one set-up is required by the service company.

(e) More uniform setting is secured than when an upstrain on the tubing is required.

Successful setting of the Baker Production Packer or the Baker Wire Line Bridge Plug is accomplished by employing a Baker Wire Line Pressure Setting Assembly in which products of combustion (whose rate of burning is retarded) are utilized for the gradual development of pressure as a controlled motive force. This force actuates the Setting Assembly which sets and packs-off the Packer or Bridge Plug. The Setting Assembly is then removed from the hole.

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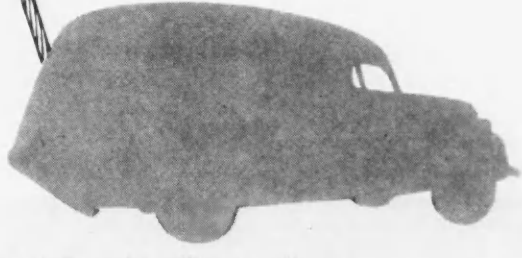

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PERFORATING GUNS ATLAS CORP., Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, Texas, Canada

SCHLUMBERGER WELL SURVEYING CORP., Arkansas, Illinois, Kansas, Louisiana, Michigan, Mississippi, Oklahoma, Texas, West Virginia

SPARTAN TOOL AND SERVICE CO., Louisiana, Oklahoma, Texas

WELEX JET SERVICES, INC., Oklahoma, Texas

THE WESTERN COMPANY, New Mexico, Texas

the computation of depreciation, which was revised for the taxation year 1949. Depreciation rates are applied to the net balances in the various classes of assets after crediting prior depreciation and the proceeds from the sale of any assets, not in excess of book value for assets on hand at the end of 1948 and not in excess of cost for assets acquired after 1948. This change was optional for 1949 but is compulsory for all subsequent taxation years. For depreciation purposes, assets are divided into 15 classes.

For example depreciation is computed on the following classes at the rates indicated:

Class 6—10 percent on frame, log, stucco on frame, galvanized or corrugated iron buildings including component parts (electrical and plumbing equipment), fences, oil or water storage tanks and railway tank cars.

Class 8—20 percent on all depreciable assets not enumerated elsewhere but specifically excepting gas or oil wells.

Class 10—30 percent on automobiles, aeroplanes, tractors, trailers, trucks, cement mixers, contractors' movable equipment (including portable camp buildings), and gas or oil well equipment that is normally used above ground.

There are two items of major importance to the oil industry which are not mentioned specifically in any of the classes. Oil well casing may be written off to expense as used but if any casing is salvaged, such salvage must be included in income.

Drill pipe may be handled in one of two ways. A basic amount of drill pipe may be included in the cost of the drilling rig and depreciated as a part of that rig, in which case additional purchases of pipe may be charged off to expense. The other method is to inventory the drill pipe at the end of each fiscal period, so that all pipe is charged to expense when consumed. By this method no depreciation is involved.

The foregoing rates are maximum and the taxpayer may claim a lesser amount. A corporation, however, may not claim for tax purposes an amount of depreciation greater than the amount deducted in computing the income or profit for the taxation year as shown on the financial statements presented to shareholders.

When depreciable property is disposed of, the proceeds are credited to the undepreciated capital cost on the books for that class, except for the excess of sales price over the undepreciated value for assets on hand at the end of 1948 and the original capital cost for assets acquired after 1948. Such excess is a capital profit and not subject to tax.

Let us take for example, Class 10, which includes automobiles, airplanes, tractors, trailers, trucks, wagons, certain types of buildings, contractors' movable equipment, oil and gas well equipment normally used above the ground, and mining machinery and equipment.

Assume that the corporation had invested $50,000 in this class of assets and that through depreciation it had reduced the residual value in this category to $20,000.

A truck acquired in 1948 for $3000 and having a depreciation reserve of $600 is sold for $2000. All the proceeds, the $2000, would be applied against the account thus reducing the balance of unrecovered cost in this class of assets to $18,000.

Assume, however, that the truck had been purchased in January, 1949, for $3000 and was sold in December, 1949, for $3500. The $3000 which was the original cost, would be credited to the class of assets and $500 would be credited to a capital gain account. Capital gains are nontaxable.

Again assume a cost of $50,000 in this class of assets with the balance reduced to $20,000 by the application of depreciation and prior sales. The company now sells a substantial number of items for a total of $25,000. In no case, however, was more than book value received for any assets on hand at the end of 1948, nor more than the original cost of any assets acquired later. Thus, under the definition there were no capital gains resulting from this sale. Applying the $25,000 proceeds to the class of assets, it cancels out the $20,000 remaining balance, and there is now a credit balance of $5000. This amount must be taken into taxable income for the taxation year in which the credit balance was created. Where the entire class of assets is disposed of and there remains an undepreciated balance, after applying the proceeds of disposition, such balance may be written off to expense in that year. Proceeds include sales price, compensation for damages and insurance.

Depletion Allowance

Where the taxpayer operates an oil or gas well, or is acting as a trustee, the deduction for depletion is 33-1/3 percent of the profits of the taxpayer for the taxation year. Where a person other than an operator or trustee has an interest in the proceeds from the sale of oil or gas, the depletion rate is 25 percent. If an amount received from an interest in the income from the operation of the well is a dividend, the above allowances do not apply but such dividends are subject to depletion at different rates, depending upon the percentage of corporate income derived from oil operations. The allowance for depletion is continuous and is not limited to the cost of the property.

A taxable loss sustained in one fiscal year may be used first to reduce the taxable profit of the previous year, and second, if any part of the loss was not absorbed by the previous year's profits, the unabsorbed part may be applied against taxable profits in the next 5 years, applying it in chronological order until the loss is finally absorbed. This is similar to the loss carry-back and carry-forward provisions in our Internal Revenue Code, except for the periods covered.

A corporation whose principal business is the production, refining or marketing of petroleum or petroleum products, or the exploring or drilling for oil or natural gas, may deduct, when computing its net income, the aggregate of the drilling and exploration costs, including all general geological and geophysical expenses incurred by it directly or indirectly on or in respect of exploring or drilling for oil and natural gas in Canada.

These allowances may be claimed only by a company whose principal business is in connection with petroleum products. They are, however, restricted to the amount of income for the taxation year so that for tax purposes a company may not create or increase a loss by writing off these types of expenses. Hence, a loss for tax purposes may arise only where expenses other than those enumerated above exceed the company's income and only in those cases will the carry-forward, carry-back provisions apply. On the other hand, if the company has incurred drilling and exploration expenses, those expenses must be written off for tax purposes to the extent that income is available.

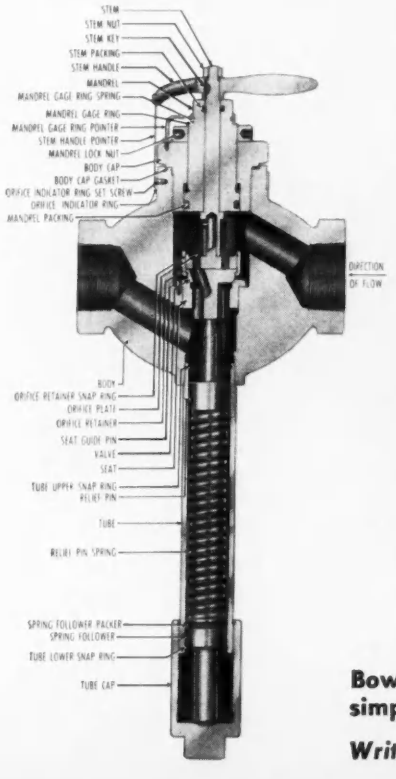
The accounts in connection with Canadian operations are naturally to be expressed in Canadian dollars. Separate books of account should be maintained for the Canadian venture, including a Canadian bank account or accounts from which payments will be made for expenses, assets acquired and for merchandise purchased. Where a Canadian subsidiary purchases expendable supplies from its parent, such supplies coming from the U. S. and being payable in U. S. dollars, the expense should be recorded on the books of the Canadian company at the Canadian dollar cost, which is 110½ percent of the U. S. dollar cost. At the same time a credit for accounts payable may be recorded on the Canadian books at the U. S. dollar cost and the difference or 10½ percent may be credited to "reserve for foreign exchange." The use of the account "reserve for foreign exchange" is optional since the full liability could be expressed in Canadian dollars. The advantage in setting up a "reserve for foreign exchange"

The BOWEN AUTOMATIC FLOW CONTROL

A Completely New And Revolutionary Device For Controlling The Flow of Producing Wells

The Bowen Automatic Flow Control installed on the flow line at the well head brings operators many desirable features that were previously unobtainable.

1. Automatically controls production.
2. Automatically prevents excessive loading.
3. Permits positive regulation at the lowest possible gas-oil ratio.
4. Reduces paraffin problems to a minimum.
5. Automatically controls gas surges.



FOR FLOWING WELLS

With a Bowen Automatic Flow Control in place and with the Relief Pin Spring adjusted so that normal pressure will hold the Valve against the Seat, fluid enters the Body as indicated on the illustration. It flows through the upper port of the Body into the upper chamber, down through the Orifice Plate and Valve and out the lower port of the Body. When the pressure drops below the setting of the Relief Pin Spring, the Valve automatically raises and allows fluid to flow between the Valve and the Seat as well as through the Orifice Plate. Thus, constant and uniform flow is insured despite low-pressure intervals. In addition, the automatic raising of the Valve during a low-pressure interval prevents excessive fluid loading from killing the well because the excessive fluid load is automatically dissipated at a desired volume and velocity. By proper setting of the Relief Pin Spring and proper selection of orifice in the Orifice Plate, the lowest possible gas-oil ratio is automatically maintained. This uniform control prevents rapid gas expansion and greatly deters the formation of paraffin on the tubing walls.

IDEAL FOR CURTAILMENT: Provides a positive means for automatically controlling production at a reduced rate with no danger of killing the well.

EXCELLENT FOR REPRESSURING: Greatly reduces the volume of gas that must be pumped into the formation.

DESIGNED FOR EFFICIENT PRODUCTION: Prevents rapid and wasteful dissipation of gas pressure and thereby prolongs the lives of flowing wells, extends the lives of pumping wells, and substantially increases the total ultimate recovery from an oil pool.

FOR PUMPING WELLS

With a Bowen Automatic Flow Control in place and with the Relief Pin Spring adjusted so that under normal pressure the valve is held off the Seat, fluid enters the Body as indicated in the illustration. It flows through the upper port of the Body into the upper chamber, down through the Orifice Plate and Valve, and between the Valve and the Seat and out the lower port of the Body. When the pressure rises above the setting of the Relief Pin Spring, the Valve automatically lowers against the Seat and the fluid can then pass only through the restricted orifice in the Orifice Plate. Thus, a sudden surge of gas cannot create disastrous sand conditions and cannot blow the hole dry and gas-locked pumps are avoided. In addition, the uniform control that is automatically maintained reduces sand and paraffin problems to a minimum.

CONSTRUCTION

Bowen Automatic Flow Controls consist essentially of a Body, a spring-loaded Valve and an adjustable Orifice Plate. The Body provides the connections to the flow lines; the spring loading on the Valve is controlled by adjusting the Tube Cap; the amount that the Valve can open is controlled by adjusting the Mandrel; the desired orifice in the Orifice Plate is selected by adjusting the Stem Handle. Upon installation, it is necessary to adjust the spring loading and the valve opening and to select the proper orifice to meet the particular conditions of the well.

Bowen Automatic Flow Controls are economical in price, easy to install, and simple to operate.

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account is to keep the account payable expressed in U. S. dollars so that the balance may easily be reconciled with the receivable account on the books of the parent. Equipment or inventory items purchased for which payment is to be made in U. S. dollars also should be debited to appropriate accounts at 110½ percent of the U. S. dollar cost.

When U. S. dollars are purchased for remittances, accounts payable will be debited for 100 percent and the 10½ percent will be debited to "reserve for foreign exchange."

With respect to transactions of this nature, since September 19, 1949, the Canadian branch gets an immediate deduction for the exchange on expense items. The foreign exchange with respect to the purchased merchandise shipped in from the U. S. will be recovered by the Canadian branch through its cost of goods sold as and when such merchandise is invoiced to customers. The Canadian branch may deduct its foreign exchange on fixed assets so purchased only through depreciation at the allowable rates.

Prior to September 20, 1949, the exchange rate was at par except a charge of ½ percent was made for converting to U. S. dollars. The Canadian dollar was worth just as much as the U. S. dollar and purchases of expendable supplies merchandise and equipment payable in U. S. dollars were recorded on the books of Canadian companies at 100 cents on the dollar. On September 19, 1949, the Canadian dollar was devalued and since that date has been worth only about 90 cents U. S.

If on that date a Canadian company owed its U. S. parent $100,000 payable in U. S. dollars, after this change in the rate the debt was $110,000 Canadian dollars. Since this indebtedness was expressed on the books in dollars at the old rate it became necessary to increase this liability by $10,000. There still would be an additional ½ percent conversion charge.

Assume that of the $100,000 indebtedness to the parent company $5000 arose from the purchase of miscellaneous supplies which when consumed are chargeable to expense on the Canadian books. Assume further that $45,000 of the account arose from the acquisition of machinery, automobiles and other equipment shipped from the U. S. having been recorded on the books of the Canadian company in the respective accounts at their cost of $45,000 and that the remainder of the $50,000 arose from the purchase of merchandise, part of which was in the inventory account of the Canadian company on September 19, 1949.

Assume further that in addition to the $100,000 owed to the parent company on open accounts payable it also owed the parent company another $100,000 on a 3-year note, the loan having been recorded on the Canadian books for this note when expressed in Canadian dollars. The Canadian company will sustain a loss of $10,000 when it acquires U. S. dollars with which to pay the notes.

With respect to tax deductions for losses on foreign exchange resulting from the devaluation of the Canadian dollar on September 19, 1949, as it relates to indebtedness on that date payable in U. S. dollars, it is expected that a directive will be issued by the Deputy Minister of National Revenue for Canada clarifying the matter.

Based on information from unofficial sources the foreign exchange loss on indebtedness relating to expense items, merchandise and equipment purchased in the U. S. probably will be allowed as a tax deduction, as and when U. S. dollars are purchased with which to liquidate these accounts.

With respect to the difference in exchange relating to the $100,000 note obligation it is believed that this will not be allowed as a tax deduction since it is in the nature of a capital loss.

With respect to the preparation of consolidated statements including one or more domestic or foreign subsidiaries operating in Canada a pamphlet recently published by the American Institute of Accountants titled, "Accounting Problems Arising from Devaluation of Foreign Currencies" deals with the problem.

In general the following principles of consolidation will apply:

1. Conversion of cash items, receivables and other current assets to U. S. dollars based on the rate of exchange at the balance sheet date. The inventory is to be stated at cost or market in U. S. dollars.

2. Fixed assets are to be included at the rate of exchange at the dates of acquisition.

3. Current liabilities are to be included based on the rate of exchange at the balance sheet date.

4. Long term liabilities are to be included at the rate of exchange at the dates the obligations were created, or at the balance sheet date, depending upon the circumstances.

Only a few of the tax and accounting problems have been discussed in this paper. There are a number of other things to be dealt with such as import duties, sales taxes, contributions to federal unemployment insurance and workmen's compensation funds and withholding tax, to mention only a few.

For U. S. corporations or individuals who contemplate engaging in Canadian operations it is recommended that contact be made with the officials of one of the larger Canadian banks, that a firm of local Canadian attorneys be engaged, and that no steps be taken except upon professional advice—and do not forget the Foreign Exchange Control Board.

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Canadian Foreign Exchange Control Board Bulletin: "Answers to Some Questions About the Unofficial Market in Canadian Dollars."

Canadian Foreign Exchange Control Regulations—Foreign Control Act.

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American Institute of Accountants' Research Department's Bulletin: "Accounting Problems Arising from Devaluation of Foreign Currency."

Booklet: "Taxation in Canada" by J. F. Cliff, the Bank of Montreal.

A. G. Burton, Chartered Accountant, Calgary, Alberta.

Venezuela Production Soars As World Markets Loosen

With loosening European and Latin American markets, and with storage depleted by the week long oil field strike in May, Venezuela production has been setting new highs. In the week ending May 29, daily oil production averaged 1,512,706 barrels as compared with the over-all daily average for 1949 of 1,252,000 barrels. The new production figure broken down by companies and sections of the country is as follows:

COMPANY	Western Venezuela	Eastern Venezuela	Daily Total
British Controlled Oilfields	1,027	.....	1,027
Creole Petroleum Co	534,030	134,298	668,328
Mene Grande Oil Co	49,182	192,412	241,594
Pantepec Petroleum Co.	.....	12,974	12,974
Phillips Petroleum Co	.....	7,904	7,904
Richmond Exploration Company	11,480	.....	11,480
Shell Oil Company	454,948	.....	454,948
Sinclair Oil Company	.....	13,005	13,005
Socony-Vacuum Oil Co.	.....	34,077	34,077
Texas-Mercedes Petroleum Company	16,800	27,487	44,287
Venezuelan Atlantic Refining	113	22,969	23,082
Total Daily Average	1,067,580	445,126	1,512,706

* * *

Surface exploratory parties in Venezuela decreased from 40 in April to 33 in May because of the rainy season. Shell Oil Company operated 10 parties, Creole Petroleum Company 5, and Socony-Vacuum 4, while the other companies operated from 1 to 3 each.

* * *

Creole's Alturitas 1, bottomed at 17,039, is the deepest well ever drilled outside of the U. S. The wildcat, 80 miles southwest of the city of Maracaibo, is near hostile Indian country where the ordinary hazards of deep drilling operations are augmented by danger from the half-civilized Indians. The wildcat had a preliminary test of 1200 barrels daily on ⅜-inch choke from the Eocene. The well was originally planned to test the deep Cretaceous limestone, which is so prolific in fields to the north such as the La Paz, Concepcion and Mara fields, but mechanical difficulties halted Cretaceous testing. The well will probably be completed the first part of July.

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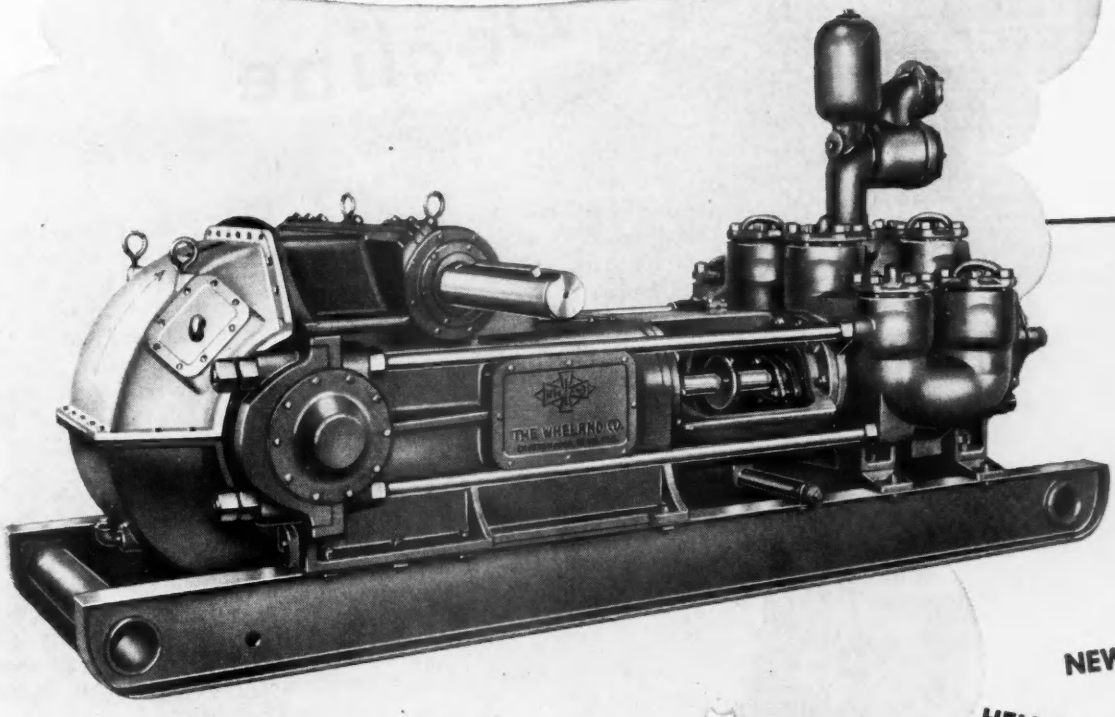

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Central Europe Faces Petroleum Decline

THE petroleum picture in Central Europe is clouding rapidly. Soviet Russia's two chief oil-producing satellites, Hungary and Roumania, face a crisis in all phases of oil activity, according to bits of information now filtering through the Iron Curtain. And in Yugoslavia the same worsening conditions prevail.

Until 1948 Yugoslavia obtained drilling equipment from Czechoslovakia, Germany and Hungary. There was also considerable old equipment left in Yugoslavia by the Germans, although these materials and equipment were of poor quality. Even the equipment imported from Czechoslovakia was so inefficient that sabotage was suspected.

To correct this condition, Yugoslavia turned to the U. S. and during 1949 received drilling equipment. Three complete outfits were received and 5 others were on order at the end of 1949, at which time Yugoslavia had in service 18 drilling outfits for depths ranging to a maximum of 5400 feet.

Compared to a daily average production during 1949 of 1040 barrels, current Yugoslavia production of about 1700 barrels a day, mostly from the three fields of Lendava, Gojlo and Mramor Brdo, is totally inadequate, and Tito has ordered extraordinary exploration efforts at Banat and other regions. If substantially increased oil production cannot be obtained at Banat, it is not expected that the Croatian and Slovenian fields will be able to produce more than 2300 barrels daily by the end of this year.

Yugoslavia's current gasoline production is estimated at only 45 barrels a day, and the best quality obtainable does not exceed 65 octane. Consumption of all petroleum products in Yugoslavia is now running 12,000 barrels a day, of which only 11 percent is covered by local production. The country is importing 3700 barrels of crude a day, chiefly from the Middle East to replace the lost source of Albania.

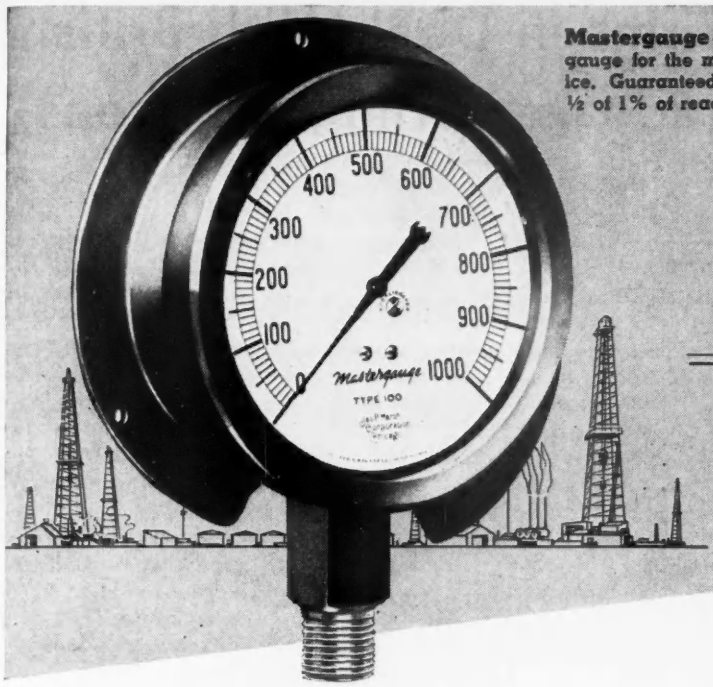
Table 1 shows Yugoslavia crude production as of April, 1950.

The Doljna field is the western ex-

Soviet drilling rig in Georgia, Stalin's home province.

TABLE 1

Field	Daily Production in Barrels
Doljna	condensate
Lendava	700
Gojlo	600
Mramor Brdo	300
Sumecan	150
Total	1750



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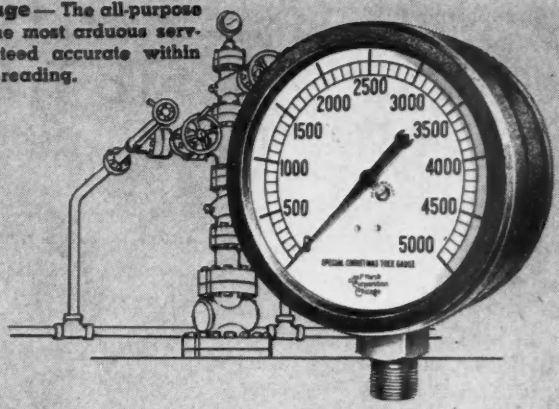

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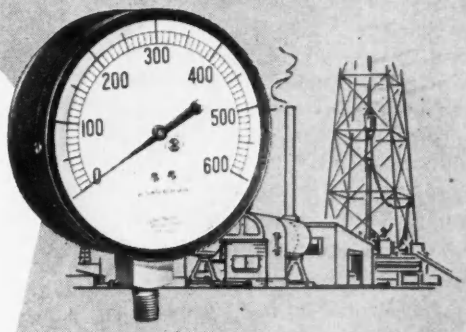

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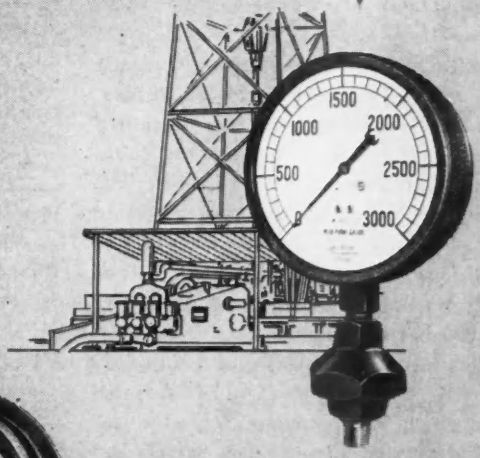

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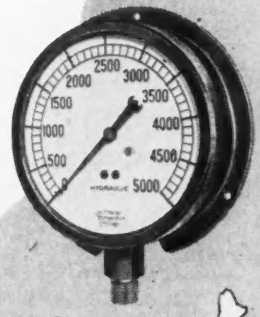

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tension of the Hungarian Lovaszi field into Yugoslavia. About 10 wells have been drilled there. The Lendava field, discovered in 1942, is on the western extension of the Lovaszi structural trend and separate from the Lovaszi field by a fault downthrown on the west. The extent of the field is about 2.4 by 1.2 miles. There are three oil pays and one gas pay in the Pliocene; drilling is to about 5500 feet. About 30 wells have been completed and 6 to 10 rigs are operating in the field now. It is believed that the productive limits have been defined. Gojlo is an old field which originally produced gas. Oil was discovered in 1938, and there are now two oil and one gas zones within the Pliocene. Drilling depth is about 3000 feet. The field is drilled up with about 45 wells, 25 of which are producing. There are two gas producers. Mramor Brdo is a recent discovery northwest of the Gojlo field. It is very small, covering only about 200 acres. Five wells have been drilled, one of which is productive. Drilling depth is about 4200 feet. The poor productivity is attributed to low permeability in the strongly folded beds.

Four rigs are now operating at Banat. In November 1949, a well north of Belgrade showed gas during a fishing job at about 6000 feet. This gas developed 2200 pounds pressure. The Yugoslavia part of the Banat Basin is deeper than in Roumania and probably has better prospects.

In Roumania there has been a steady decline in all oil work excepting drilling. The 1949 production scarcely amounted to 29 million barrels against the country's program of 32 million barrels. The decline is accelerating at an alarming rate. Refining activity also is declining.

Hungary's crude production fell to 3,371,000 barrels for 1949, a decrease of 329,000 barrels, or 9 percent from 1948, and a drop of 958,000 barrels, or 22 percent, from 1947 output. One small field which was discovered at Sojter near Hahot yielded about 10,000 barrels last year, but has failed to achieve earlier expectations. Drilling activity is continuing at about the same rate of a year ago, but no new rigs have been added to the 7 with which MAORT operated prior to the confiscation of its property. Exploratory drilling is being confined chiefly to the immediate vicinity of the producing fields.

Russia is also having its share of petroleum troubles. The highly touted Ishimbaevo field in the Ural-Volga area has not developed into a second Baku as was originally expected, and the Soviets turn more and more to stripping oil from Hungary, Roumania and Austria.

U. S. Firms in Deal With British To Trade in Sterling Oil Areas

THE British government finally has reached an agreement with two U. S. oil companies by which American oil produced in the Middle East can be sold for sterling both inside and outside the sterling area. This deal with the Standard Oil Company (N. J.) and the Socony-Vacuum Oil Company is the first break in the British restrictions instituted last January against American oil companies. If the curbs had not been softened, this effect would have been virtually to squeeze dollar oil out of the principal world markets.

Somewhat earlier the British government purportedly had effected another arrangement with the Standard-Vacuum Oil Company, a wholly owned Jersey Standard and Socony-Vacuum affiliate, whereby Standard-Vacuum would be permitted to sell its East Indies production in the sterling market for sterling payment. Britain is said to have provided a dollar conversion principle for Standard-Vacuum, beginning at 40 percent of sterling earnings, but stepping down sharply over a 3-year period.

However, the agreement with Jersey Standard and Socony-Vacuum as partners of the Iraq Petroleum Company goes far beyond the Stanvac deal, since now Britain will allow at least some competition with sterling oil for sterling payment outside the sterling area. The two American companies are 23.75 percent owners of IPC which operates the lush Iraq field at Kirkuk. In order to accept the British offer to sell within the sterling area, they must set up British marketing subsidiaries to buy the Iraq crude from the American parent companies and re-sell it for sterling.

This device will enable Britain to tax the American operations through the companies' British subsidiaries. The American parent companies, in turn, are to receive any and all sterling profits of their subsidiaries in converted dollars.

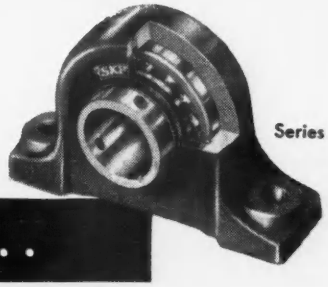
For oil sales outside the sterling area, Jersey Standard and Socony-Vacuum must pay for crude purchased from the IPC at the rate of 25 percent in dollars and 75 percent in sterling. This IPC purchased oil is sold at cost to the American firms as IPC partners. The U. S. companies then can ship this oil to non-sterling areas of the world and sell it there for sterling payment up to the value of the 75 percent original sterling price.

The moderating of the British restrictive curbs from the Stanvac to the IPC arrangement is seen as evidence that London at last has yielded to strong pressure from both the U. S. government and American industry for some program that will prevent dollar oil from being displaced all over the world. In the Stanvac agreement, the American oil was practically considered a sterling commodity and its sale was restricted to the sterling area. Also, the profits conversion plan from sterling into dollars was not thoroughgoing. Under the IPC deal, Britain recognizes that dollar oil as well as sterling oil has a place in the world's markets, and that American oil companies can compete with British operators both inside and outside the British trade zones. Furthermore, the profits conversion plan is deemed satisfactory by the American companies.

One interesting speculation about the agreement concerns the possibility of the two American companies selling part of their Iraq production inside the U. S. In that case the American operators would pay only 25 percent of the cost of this oil in dollars; the balance would be paid from sterling balances held by the Americans in the sterling area. This arrangement, it is suggested, might so lower the cost of foreign oil, dollarwise, as to prompt increased importation.

Stepped up sales of American oil are expected in the United Kingdom as a result of Britain's removal of gasoline rationing. American petroleum marketing firms in England have been asked to sell to the sterling area for sterling payments proportionate shares of the increased quantities of products that will be needed with the end of rationing. Standard Oil supplies more than a quarter of Great Britain's gasoline requirements. In accepting the British invitation to expand its supplies to the U. K., Standard said:

"This latest plan is intended to cover the period between now and completion of the new Esso refinery under construction by Anglo-American Oil Company at Fawley, near Southampton. This huge plant, the largest in Europe, will refine 110,000 barrels daily of petroleum products from Middle East crude oil. It also will contribute substantial dollar savings to the British Economy. Although work is going forward as rapidly as possible, the project is not expected to be completed before 1952. After the new refinery goes into operation, it will produce enough sterling gasoline to supply Anglo-American's requirements without relying on gasoline from dollar sources."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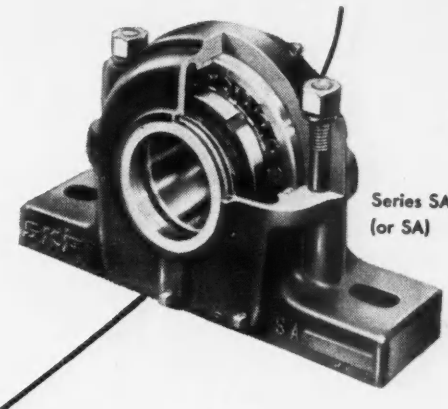
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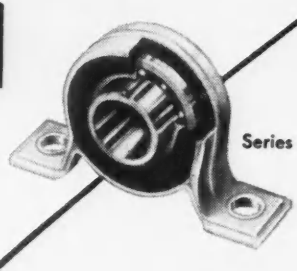
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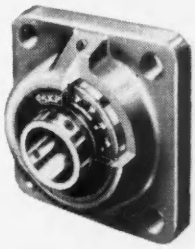
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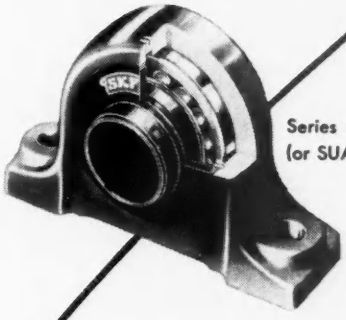
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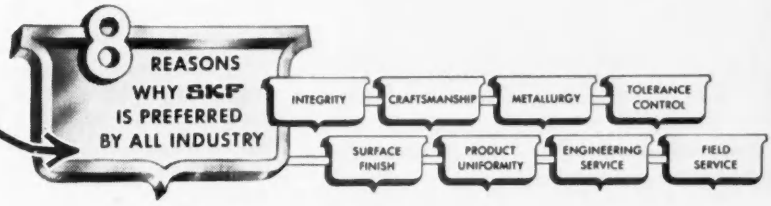

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Government Won't Hold Major Part of De Mares Concession

The Colombian government has tacitly admitted failure in its plan to take over the De Mares concession as a state-controlled operation. Instead, private Colombian capital will dominate the mixed company now being formed to operate the property after Tropical Oil Company retires from the concession. The government-private company, Empresa Nacional de Petroleos, will be only 45 percent held by the Colombian government.

Originally, Colombia had notified Tropical that no more than 49 percent private interest would be accepted in any agency for operation of the concession after expiration of the present contract. Tropical refused to accept such terms, and later Colombia private capital likewise refused, and forced the government to yield majority control.

The De Mares concession is a 1,265,000-acre property in the Central Magdalena Valley and is Colombia's best producing area.

The new mixed company will have an initial $15 million of private capital contributed by a group of Colombian financial and industrial leaders known as ANDI. The government will put up the property itself as its share of the new company's assets. The $30 million figure as the current worth of the concession was determined on the basis of a valuation of $15 million for the above-ground installations and on estimates of 100 million barrels reserve underground in the concession.

In addition to winning control of the mixed company, the private capitalists also will name the general manager for the concession, and have been assured that existing royalty rates of 10 percent will continue. No bonus will be paid by the ANDI group.

It is deemed unlikely that any American or other foreign capital will go into the new mixed company. While the Colombian ANDI group and the government itself are ready to accept foreign participation on a minority basis, it is understood that no American oil company has yet expressed a willingness to so associate in the project.

Tropical will preserve its marketing structure in Colombia together with some carry-over exploration rights. The De Mares concession is producing in excess of 30,000 barrels daily from its 4 principal fields, or more than 40 percent of the entire crude output of Colombia.

ECA To Finance Drilling in France and North Africa

The Economic Cooperation Administration announced in June that it would finance oil well drilling in France and French North Africa to the extent of $2,654,000. France holds a little under a quarter interest in the Iraq Petroleum Company, and upon completion of that company's big-inch pipe line from Iraq to the Mediterranean, the country expects to obtain 140,000 barrels of sterling oil daily from Iraq. Meanwhile, ECA funds are earmarked for developing French domestic production.

Of the funds to be given France for exploratory work, $200,000 go to Societe d'Etudes et de Recherches Petrolieres for the purchase of a medium drilling rig and necessary accessories for drilling operations in the Middle Alsace area. Pechelbronn Societe Anonyme d' Exploitations Minieres is to receive $400,000 for the purchase of 2 medium drilling rigs and accessories for use in the Bas-Rhin area. Regie Autonome des Petroles will receive $200,000 for the purchase of a heavy drilling rig capable of drilling to 15,000 feet. This company will use the rig north of the St. Marcet field. Societe Nationale des Petroles d' Aquitaine will receive $275,000 for the purchase of a medium rig, capable of drilling to 5000 feet, and a light rig, capable of drilling to 1500 feet. Their operations will be mostly in Southwest France. Societe Nationale des Petroles du Languedoc Mediterranean will receive $279,000 for the purchase of 2 medium drilling rigs to be used in the Herault area.

In addition to these grants in continental France, 2 colonies in North Africa will receive $1,300,000. SN. REPAL operating in Algeria will receive $220,000 for maintenance and replacement of drilling equipment as well as $500,000 for additional drilling equipment. Societe Cherifienne des Petroles, operating in Morocco will receive $580,000 for maintenance and replacement parts for its drilling equipment.

Expected New Oil Law May Stimulate Activity In Peru

Revival of petroleum activity is expected in Peru with the anticipated establishment of a new oil law late this year. Many industry sources believe that the legislation which has been pending for 3 years may be promulgated by executive decree and thus open the door for new work by American concerns.

Conorado Petroleum Corporation, joint foreign arm of Amerada Petroleum Corporation, the Ohio Oil Company and Continental Oil Company, has a gravity meter party at work in Peru's north coastal area, and has a geologist on the ground as well. International Petroleum Company, it is understood, has been authorized to make geological surveys and tests in the Pucalpa area and extending to within 35 miles of the eastern frontier.

Dunlap and Graham, drilling contractors of Long Beach, California, have been employed to drill 10 wells in the Zorritos zone of north Peru.

Shell's Australian Test May Be Drilled to 10,000 Feet

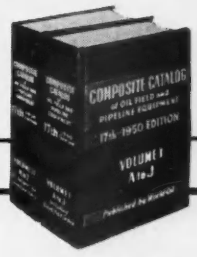
E. N. Avery, general manager for Shell Company of Australia, Ltd., announced that Shell (Queensland) Development Pty., Ltd., spudded a deep test at Morella, 100 miles south of the Springsure railhead.

Avery said: "The drilling plant and equipment at the site will permit drilling to a depth of 10,000 feet. Whether we do or do not drill to this depth will depend upon a variety of conditions—geological and mechanical—and they can only be assessed as the work progresses."

Chester M. Crebbs, left, retired president of Mene Grande Oil Company, C. A., was presented the second highest Venezuelan decoration in a ceremony at the Venezuelan Embassy, Washington, D. C. Jose Rafael Pocaterra, right, Venezuelan Ambassador to the U. S., made the award. The decoration, the Order Francisco de Miranda, second class, was presented to Crebbs as reward for his "services made to science, to progress of the country and to outstanding merit." Crebbs recently completed 31 years with the Gulf companies, 26 of which were spent in Venezuela.

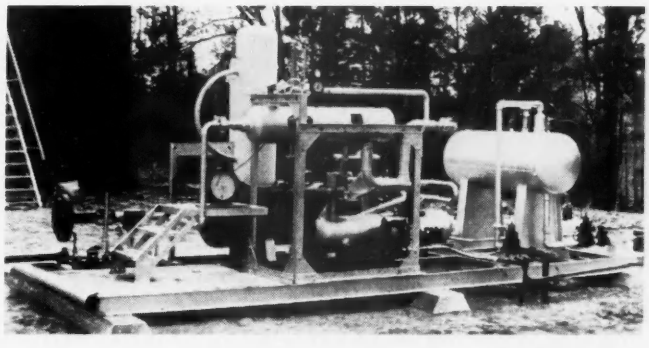
NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG



232—Low Temperature Separator

This item supplements Parkersburg Rig & Reel Company data as shown on pages 3993-4028 of Composite Catalog, 17th Edition.



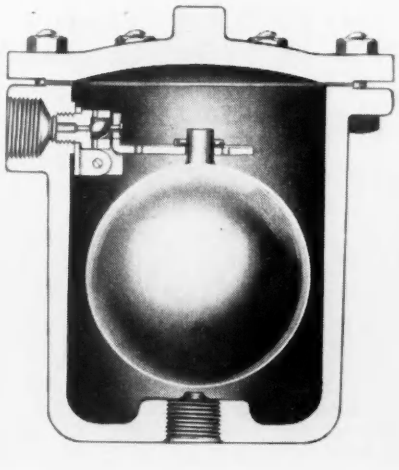
A new packaged high-pressure separation unit utilizes lower temperatures than previously possible to permit high recovery of liquid hydrocarbons from a gas stream. Developed after three years of extensive field testing and proving, the Hyreco Unit employs a high-pressure mechanical water knockout that removes much of the entrained water at line pressure before the gas stream is allowed to expand through a choke where refrigeration occurs. These lower temperatures are made possible by removing a maximum of water before gas expansion so that very little hydrates form in the cooled separator where the hydrocarbons condense.

The Hyreco processing unit represents a new and practical approach to the problems encountered in the production of high-pressure gas condensate wells. No heating is required, thereby eliminating a possible fire hazard on the lease. Units now in service are reported to be operating trouble-free with separator temperatures at zero and below.

For additional information write Parkersburg Rig & Reel Company, Parkersburg, W. Va.

233—Automatic Valve

This item supplements Crane Company data as shown on pages 1282-1283 of Composite Catalog, 17th Edition.



A simplified ball-type seating mechanism is used instead of the customary disc, in a new automatic vent and drain valve. The valve may be installed in water or oil piping systems to remove entrapped air, or in compressed air systems to remove water and oil. Operation is fully automatic. The cycle of filling and emptying repeats with each accumulation.

A range of sizes is available for all air requirements up to 150 pounds per square inch, and water up to 125 psi. Body and cap of the valve are cast iron, and the float is copper. The ball seat is Excelloy, and the ball is of hardened stainless steel.

For additional information, write Crane Company, 836 South Michigan Avenue, Chicago.

234—Pipe Inspector

This item supplements Tuboscope, division of Tubular Service and Engineering Company, data as shown on pages 4790-4791 of Composite Catalog, 17th Edition.

A new method of non-destructive testing of metals, Sonoscope, supplements the standard inspection procedures of Tuboscope in examining drill pipe, tubing and casing.

The Sonoscope method utilizes the induction of electro-magnetic energy, in conjunction with controlled ultra-sonic stressing, in the piece to be tested. The flow of this energy in the test piece is modified significantly by mechanical discontinuities and also by variations in the internal structure of the metal. These discontinuities and variations in structure are located and recorded in permanent graph form.

Consisting of the inspection unit and truck with control panel, Sonoscope equipment is designed for laboratory precision in the field. In testing, the vibro-magnetic unit and detector travel the full length of the pipe.

For additional information, write Tuboscope, division of Tubular Service & Engineering Company, Commerce Building, Houston.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

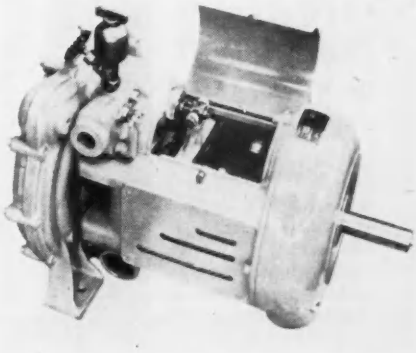
235—Steam Turbine

This item supplements Moon Manufacturing Company data as shown on page 3315 of Composite Catalog, 17th Edition.

For use in explosive atmospheres, the Moon "Little Giant" steam turbine is designed for powering shale shakers, pumps, fans, blowers, compressors or similar apparatus. Construction is suitable for close coupled units. The engine may be mounted either vertically or horizontally.

Only 26 inches long by 16 inches high by 16 inches wide, the Model TE-5 delivers 5 horsepower at 2000 to 3600 revolutions per minute. A larger model TE-15 turbine, of the same design, is rated 15 horsepower at 3600 rpm.

The turbine has grease sealed bearings which require little attention. A new type



governor valve and control mechanism provides close speed regulation without "hunting." The fully enclosed, weatherproof construction conceals governor controls with no levers or links exposed to damage. A positive overspeed valve prevents damage in the event of a failure to any part of the governor mechanism.

For additional information, write Moon Manufacturing Company, 128 North Jefferson Street, Chicago 6.

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REFLEX and TRANSPARENT
DROP FORGED STEEL LIQUID LEVEL GAGES

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Drop Forged Steel
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Empty Space Shows White
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Due to "Reflex" principle, liquid always shows black and empty space white. Liquid level is indicated instantly and unmistakably. Made of temperature resisting alloy steel for high pressure and temperature service. Conforms with API and ASME requirements.

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TRANSPARENT
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GAGES

Glass front and rear permits observation of color and density of liquids under high pressures and/or temperatures. Highest quality—made of temperature resisting alloy steel. Conforms with API and ASME requirements.

3277-C

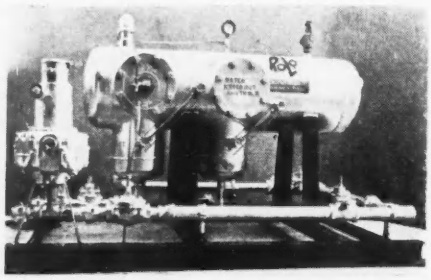
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

236—Wellchecker

This item supplements Rolo Manufacturing Company data as shown on pages 4313-4317 of Composite Catalog, 17th Edition.



A new API-ASME code-labelled wellchecker is designed to handle prorated wells and small strippers. With an oil and gas separator 16 inches x 4 feet x 125 pounds working pressure, the Rolo 4-1H-1604 handles from 5 to 500 barrels of fluid and a maximum of 200,000 cubic feet of gas per day. It may be either trailer or skid-mounted. Where free water is prevalent, the unit may be equipped with automatic water knockout.

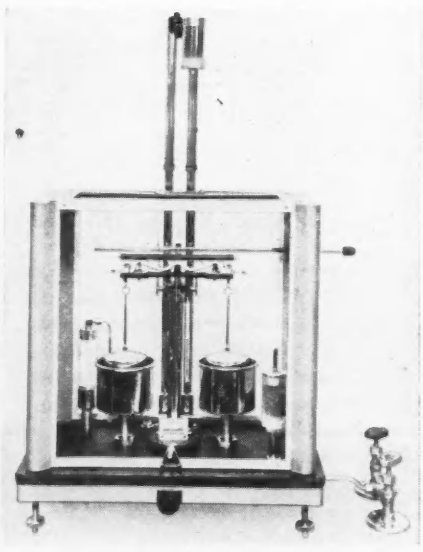
For additional information, write Rolo Manufacturing Company, 2510 South Boulevard, Houston.

237—Gas Balance

This item supplements American Recording Chart Company data as shown on pages 338-339 of Composite Catalog, 17th Edition.

Specific gravity of a gas sample brought in from the field can be readily determined with a new instrument permanently installed in the laboratory.

The operating principle of the Arcco-Anubis laboratory gas balance is identical to that of the dry air type gas gravitometer, wherein the comparative weight of a column of dry air and equal column of gas determines the specific gravity. An air dryer is used to remove moisture. The instrument also correct for temperature and barometric pressure.



The gas sample required is extremely small, and no manometer or gas vacuum pump is necessary.

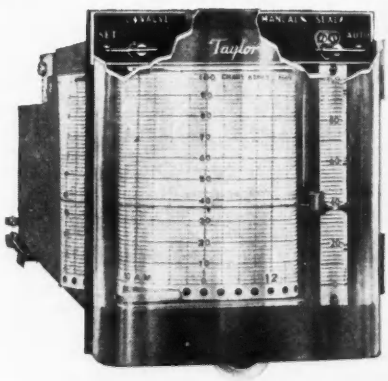
The instrument handles a wide range of specific gravity from .0 to 2.5 without loss of sensitivity.

For additional information, write American Recording Chart Company, 3105 East 11th Street, Los Angeles 23.

238—Recorder

This item supplements Taylor Instrument Companies data as shown on page 4650 of Composite Catalog, 17th Edition.

The Transet recorder is a new miniature recording-receiving instrument for



pneumatic transmission of flow, liquid level, pressure and temperature.

The compact unit is suited for either graphic or conventional panels. It fits into a panel opening of 3⅞ x 4¼ inches, with a flange measurement of 4⅜ x 5 inches. The door of the recorder is of clear, durable plastic to give full view of the chart, scale and all principal instrument settings. When the door is opened, adjustments can be made for instant checking of the valve position and for automatic-manual service. Set-point adjustment is made by turning the knurled knob at the bottom of the case. Two micrometer screws above the automatic-manual level provide a means for making zero adjustments for pen and set-pointer.

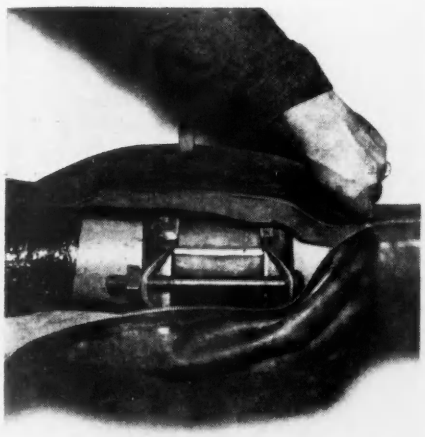
The Transet records the transmitter output in terms of the process variable measured. The 3-inch wide chart travels from right to left, 1 inch per hour, to produce a record similar to one plotted by an engineer.

For additional information, write for Bulletin 98079, Taylor Instrument Companies, 95 Ames Street, Rochester 1, N.Y.

NEW EQUIPMENT
SUPPLEMENTING COMPOSITE CATALOG

239—Protective Cover

This item supplements Dresser Manufacturing Division data as shown on pages 1382-1384 of Composite Catalog, 17th Edition.



"Zipcoat," a tough coating for protecting coupled pipe joints, welded joints, and insulating joints from corrosion, is applied by closing the zipper fastener.

Several styles are available, including Zipcoat for couplings, designed to cover and protect a Dresser coupled joint. Each has a bleeder valve to vent air during backfilling. Zipcoat for welded joints is for the protection of a circumferentially welded joint. For insulating joints the material is similar to that for welded joints, but comes in 10-foot lengths.

The coatings have high dielectric strength and give protection that equals or exceeds that of mill or yard-wrapped pipe, the manufacturer states. Each contains anaerobic microbiological corrosion inhibitor.

For additional information, write Dresser Manufacturing Division, 59 Fisher Avenue, Bradford, Penn.

240—Air Compressor

This item supplements Worthington Pump and Machinery Company data as shown on pages 5145-5164 of Composite Catalog, 17th Edition.

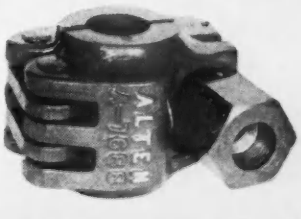
Designed to operate in rough terrain and on unusually steep inclines, a new 500-foot pipe line model Blue Brute portable air compressor has a standard engine and compressor unit mounted on pneumatic tires. It is built to give continuous performance under the unfavorable dusty conditions encountered in pipe line construction.

The unit has a special oil bath air cleaner, a steep angle oil sump, and a readily accessible heavy duty replaceable cartridge oil filter.

For additional information, write Worthington Pump and Machinery Corporation, Construction Equipment Division, Holyoke, Mass.

ALTEN
EQUIPMENT

THE WORLD OVER



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ASK FOR COMPLETE ALTEN LINE
AT YOUR LOCAL SUPPLY STORE

ALTENS FOUNDRY & MACHINE WORKS, INC.
LANCASTER, OHIO, U. S. A.

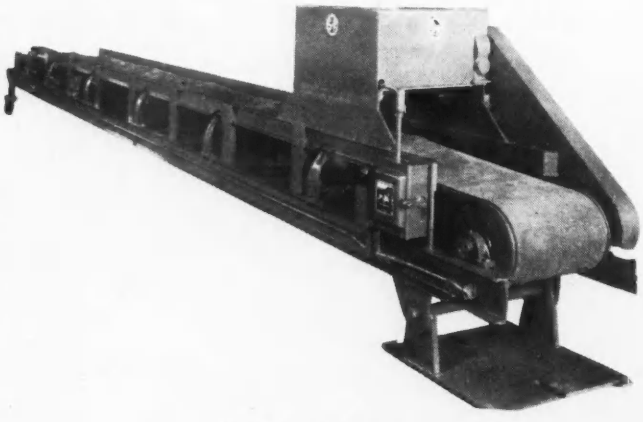
ALTEN

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

241—Drilling Barge Mud Conveyor

This item supplements S & R Tool and Supply Company data as shown on pages 4369-4376 of Composite Catalog, 17th Edition.



Special mud conveyors for drilling barge use are built for heavy duty service, equipped with reversible belt, troughing idlers and with chain drive. Both drive and electric motor are under easily accessible protective housing. The unit operates efficiently to 35 degrees off horizontal, according to the manufacturer.

The equipment is custom built to meet requirements up to a maximum length of 40 feet.

For additional information, write S & R Tool and Supply Company, P. O. Box 1755, Houston 1.

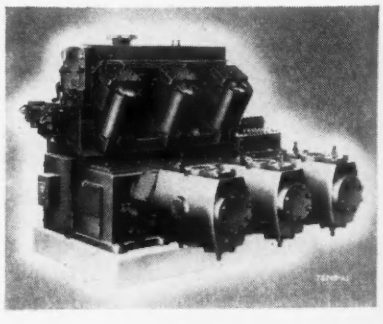
242—Compressors

This item supplements Ingersoll-Rand Company data as shown on pages 2465-2472 of Composite Catalog, 17th Edition.

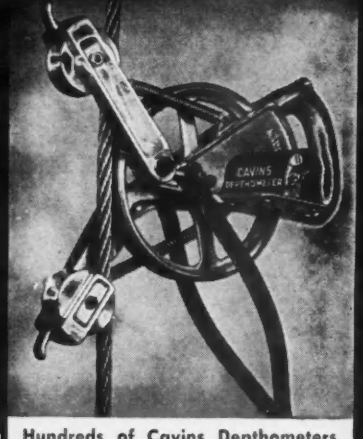
Three sizes, 110, 165 and 220 horsepower, are available in a new line of gas engine driven compressors. The machines consist of 4, 6 and 8 power cylinders respectively, having an 8¼-inch bore and a 9-inch stroke and have 2 power cylinders for each compressor frame.

The JVG is a small, compact compressor of the 4-cycle, V-angle design, with power connecting rods articulated with the compressor rods. It is light enough for semi-portable use in the field.

For additional information, write for Form 3127-A, Ingersoll-Rand Company, 11 Broadway, New York 4.



Here's the Accurate Way to take Wire Line Measurements



Easy to use

Light and handy to carry

No more "Stringing-in" Guess Work

Gives you accurate depth

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Pays for itself in a short time

Hundreds of Cavins Depthometers are in successful service giving their owners direct-reading, accurate well measurements. This strong, simple device comes in a handy carrying case (weighs only 17 pounds)—is put on the line in a few seconds, and tells you where bottom is quickly and dependably. —Write for folder to The Cavins Co., 2853 Cherry Ave., Long Beach 6, California.

THE CAVINS DEPTHOMETER

S & R THREAD PROTECTORS

Save collar and sub thread damage! S & R thread protectors not only prevent damage to joints, but also provide a simple, safe and convenient means for lifting heavy drill collars and subs.

Made of cast steel, carefully machined to established specifications. They will make up and shoulder like any standard tool joint. The heavy lifting eye is cast integrally with the body of the protector . . . provides plenty of room for winch or cat lines. Available for any standard tool joint thread, from 2⅞" to 6⅝". All threads cut extra long to accommodate extra long joints on collars or subs.

Save damage . . . save money . . . the cost of recutting one thread on a collar or sub is usually more than the cost of an S & R protector.

Export: 233 Broadway, N. Y. 7, N. Y.

S & R TOOL & SUPPLY CO.
P. O. Box 1755 155 McCarty
HOUSTON 1, TEXAS

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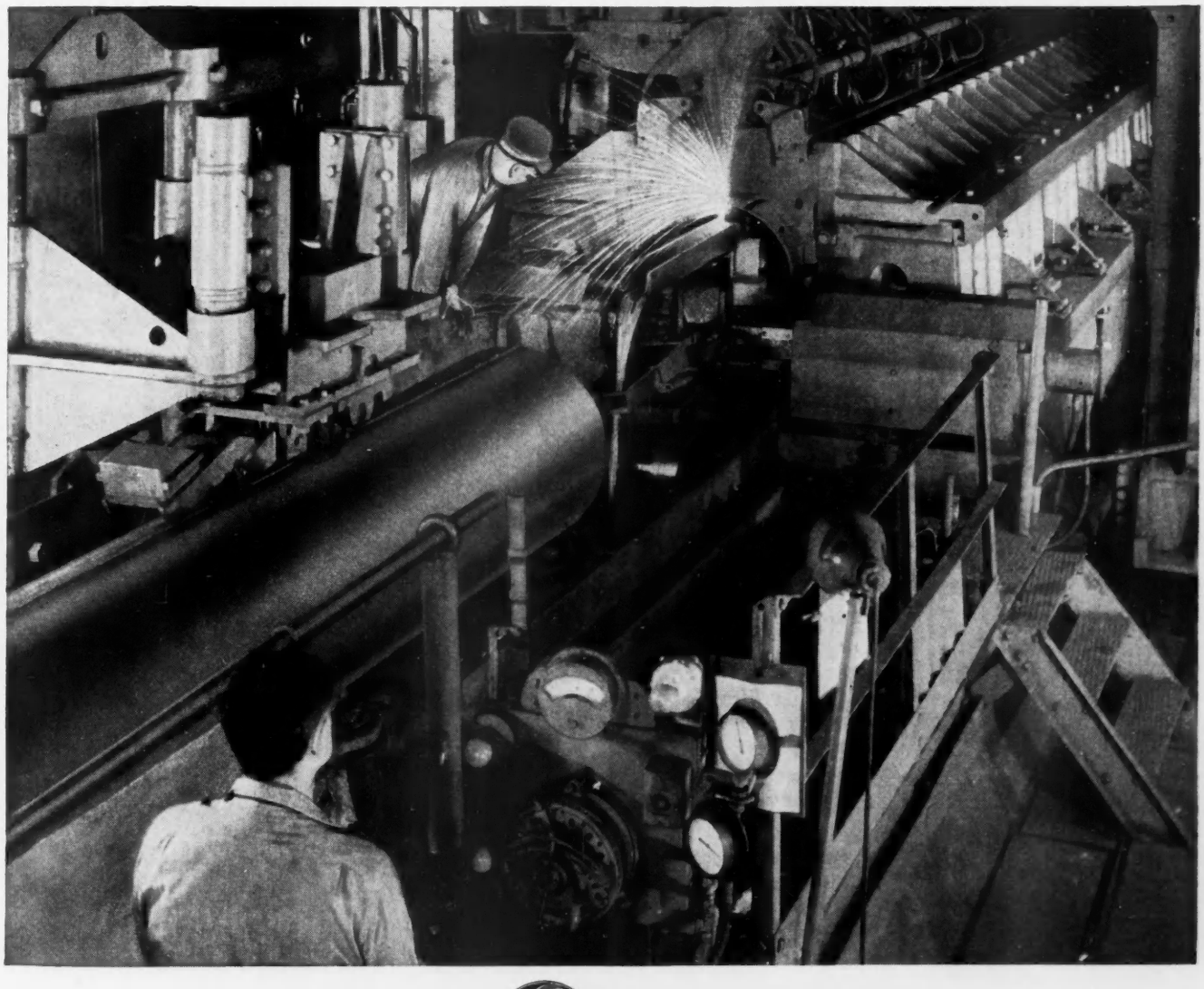
A. O. Smith Line Pipe is flash resistance welded — simultaneously along each 40-ft. length — in an automatic welding machine like the one shown. After each steel plate is formed in a series of hydraulic presses, it moves into a welding machine where a million-ampere current-flow heats the seam edges to a semi-liquid state. Sudden pressure then unites the edges, forming a clean, sound, strong weld.

This and other steps, from special steel specifications through final inspection, comprise the exclusive SMITHway process of line-pipe manufacture which assures a stronger, more uniform product.

A. O. Smith Line Pipe is produced in a complete range of sizes and wall thicknesses, from 8⅝" to 36" diameter. Write for Bulletin No. 576.



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A.O.Smith

LINE PIPE • CASING

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

243—Generator Units

This item supplements Cummins Engine Company, Inc., data as shown on pages 1293-1312 of Composite Catalog, 17th Edition.

A standard commercial line of Cummins diesel-powered electric generator units includes 60-cycle units available in 40, 50, 60, 75, 100, 125, 200 and 250 kilowatt ratings. Similar units are also available for 50-cycle operation at a slight de-rating in KW capacity.

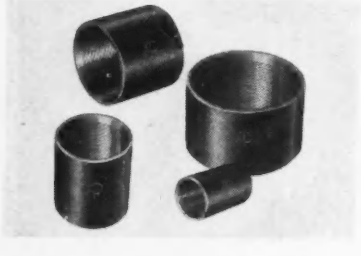
These diesel generator units are designed for continuous service applications where the unit is the primary source of power. Their instant starting and high availability characteristics also make them suitable for standby or emergency sources of power.

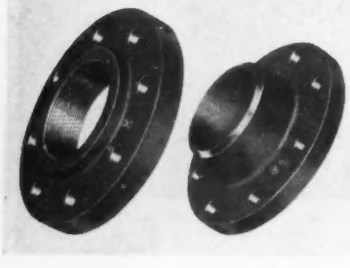
Optional equipment for the various generator units includes automatic over-speed shut-down control; automatic high temperature and low lubricating oil pressure shut-down; complete marine-type or radiator-type cooling systems; hydraulic governor; water-cooled exhaust manifold, and generator mounted package control unit. Special generator voltages and KW ratings are also available.

The unit consists of the engine direct connected to a single bearing generator, the engine and generator being mounted on a common structural steel sub-base.

For additional information, write Cummins Engine Company, Inc., Columbus, Indiana.

is a shorter distance, more economically covered, when your Couplings and Flanges perform right!





No question about it, **reliable** Couplings and Flanges play a big part in delivering a better product to the ultimate consumer.

Harrisburg Couplings (made to A.P.I. specifications) and Harrisburg Flanges (manufactured to A.S.A. standards) have an enviable reputation for **reliability. They perform** right because they are **made** right.

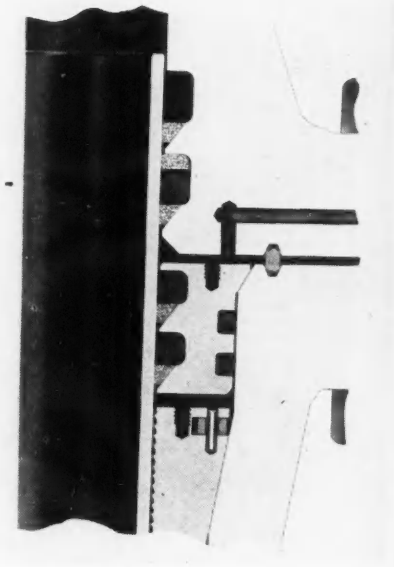
Ninety-seven years of manufacturing experience and keeping promises is behind those statements!

HARRISBURG
STEEL CORPORATION
Harrisburg 8, Pennsylvania

Custom-Built Quality Products in Quantity
97 YEARS IN PENNSYLVANIA'S CAPITAL

244—Casing Head

This item supplements Oil Center Tool Company data as shown on pages 3645-3684 of Composite Catalog, 17th Edition.



A new 20,000-pound test automatic floating seal casing head with extra heavy seal rings, designated the C-18-H, is available in either a combination welded and oversized "O" ring seal or in an all oversized "O" ring seal type.

Because slips and seal are separate units, test loads are applied to the automatic sealing element and not to the slips. This removes the possibility of collapsing or crushing the pipe with test loads. The test load is applied to the heavy bevel on the body.

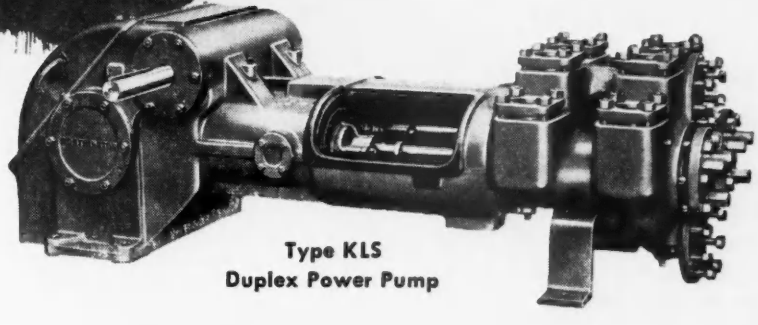
Allen screws have been eliminated and well pressure is utilized to equalize the seal all around the pipe. Seal rings are backed up by extrusion rings which conform to the plus or minus API tolerances of the casing. The extrusion rings, the manufacturer claims, prevent the seal rings from flowing out under maximum pressures. Corrosive gas and fluids are sealed off from the API metal seal ring gasket between flanges.

For additional information, write Oil Center Tool Company, 1912 Airline Drive, Houston.

THE GOOD RIGHT HAND OF INDUSTRY

You Get Any Type of Pump—FAST

From the Local Worthington Stock



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Duplex Power Pump

You need a pump—*fast*. You get your *pump*—any type of pump—*fast* by getting in touch with your Worthington dealer, who is as close as your phone.

There's a Worthington dealer at every oil center, and he has large stocks of all types of pumps and repair parts. His stocks are backed up by *complete* warehouse stocks at Tulsa, Houston, New Orleans, Los Angeles and San Francisco.

Remember—there's a Worthington pump for every pumping job . . . rotary, power, centrifugal . . . in a complete range of sizes. For example—

KTS 12-in. horizontal duplex power pump in bores from 3½ to 7½ in. (by half-inches).

KDS 4-in. horizontal duplex power pump in bores from 2½ to 4 in. (by half-inches).

So remember—Worthington is *everywhere* . . . Worthington supplies *every* type of *pump*. Rely on your Worthington dealer for your rush requirements.

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
PUMP AND COMPRESSOR MERCHANDISING DIVISION
HARRISON, NEW JERSEY

The Good Right Hand of Industry

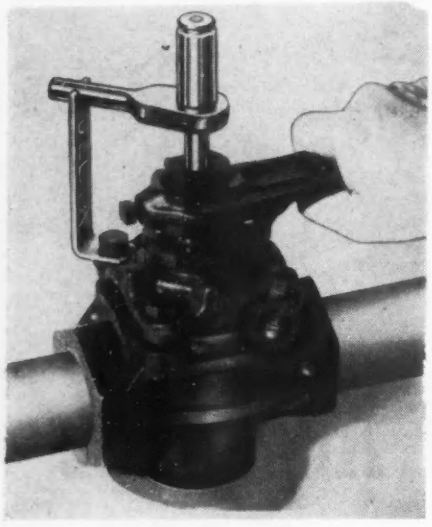
POWER TRANSMISSION: sheaves, V-belts, variable speed drives
PUMPS: centrifugal, power, rotary, steam
AIR COMPRESSORS: water-cooled, air-cooled

PCS922

OTHER NEW AND IMPROVED EQUIPMENT

245—Valve Lubricator

Valves from ½ inch to 20 inches can be lubricated with the new Delta automatic plug valve lubricator. It forces a measured amount of lubricant into the lubricating channels of the valve each time it is opened and closed. The lubricator is composed of 3 stainless steel parts.



The valve may be opened and closed 50 to 100 times before the reservoir must again be filled. To reset and refill with lubricant, the hose connection of a Delta lubricant gun is snapped on the top fitting, the plunger handle is given a few strokes, and the reservoir is filled.

For additional information, write Delta Engineering Sales Company, 806 Louisiana Avenue, Shreveport.

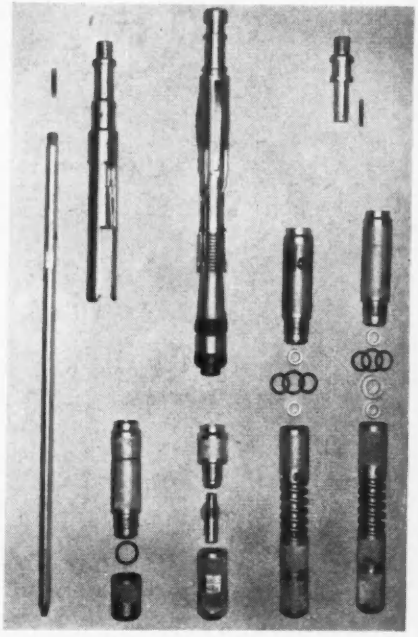
246—Fastening Tool

A small powder charge used in a new fastening tool, the "Drive-It," drives a hardened steel drive pin or stud into steel, concrete, and similar tough materials. The drive pin imbeds itself, at high velocity, in the material, and once imbedded will withstand hundreds of pounds of direct pull. It is highly resistant to vibration. No drilling or previous preparation is required.

For additional information, write Powder Power Tool Corporation, 0719 S.W. Woods Street, Portland 1, Ore.

247—Subsurface Controls

A new type of subsurface well controls are set and released by surface manipulation of the wire line, independent of well pressure or flow. These retrievable wire line controls may be set in any tubing string regardless of well pressure or flow.



The controls can be set at any point of tubing string without need of previously installed landing nipples. The integral slip construction prevents possible slip loss. The universal mandrel assembly is suitable for holding upward or downward pressure of either gas or liquid.

For additional information, write Technical Development Company, 5513 Clinton Drive, Houston.

248—Plastic Coatings

Plastic base coatings, designated Series V-200, may be used wherever a simplified coating system is required to protect equipment or materials from strong corrosive liquids and fumes. They are available in clear or colors, and may be applied by spray, dip or brush. The coating is flexible, abrasion resistant and highly adherent even to polished metal surfaces.

Another series, the V-100, is of the removable type and is used for masking purposes, and to prevent corrosion, scratching or abrasion of materials during production, assembly, shipping or storage.

For additional information write Specialty Coatings Laboratory, 1721 North Water Street, Milwaukee 2, Wis.

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DAILY Flights to

VENEZUELA and JAMAICA!

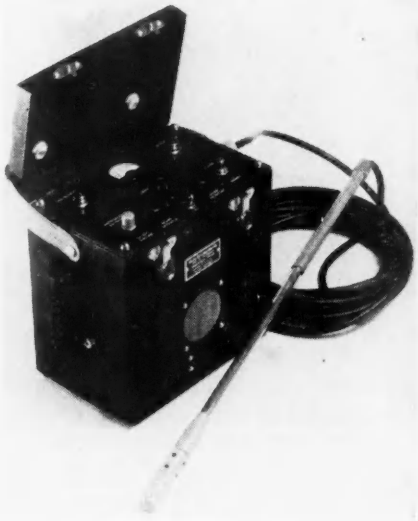
Chicago & Southern Air Lines' fleet of 4-motored Douglas Skymasters now offers seven-days-a-week service through the Houston and New Orleans gateways to Caracas, Kingston, and Havana. Flights each way every day provide one-plane service from the Great Lakes to the Venezuelan oil capital. Ask your travel agent or nearest C&S ticket office.

CHICAGO & SOUTHERN AIR LINES

General Offices, Memphis, Tenn., U.S.A.

C★S

249—Gas Indicator



An alarm is sounded immediately by a new combustible gas indicator when the gas concentration exceeds 20 percent of the lower explosive limit of combustible gases or vapors in the atmosphere where it is placed. Action is entirely automatic and readings are continuous. The detector head is placed outside the instrument case and makes instantaneous contact with gases present in the atmosphere. When the concentration exceeds 20 percent of the lower explosive limit, a red signal burns on the control panel simultaneously with the sounding of the alarm.

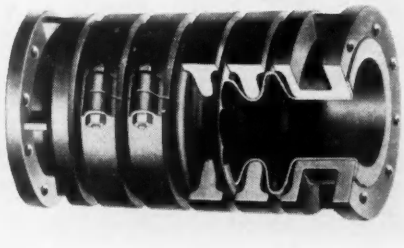
The instrument is also equipped with a detachable probe head and 25 feet of cord. When the probe head is in use, the detector on the side of the instrument is automatically inactive. The weather-tight steel indicator case is 8½ x 8½ x 5¾ inches, and weighs 18 pounds.

For additional information, write Atlas Exploration Company, 1911 West Alabama, Houston.

250—Expansion Joint

Expansion and contraction caused by temperature changes in pipe lines can be controlled by new packless, in-line, corrugated expansion joints. Joints are available in either controlled flexing type with control rings for high pressure, or free flexing joints without control rings for lower pressures.

Available in sizes from 3 to 24 inches inside diameter, the joints are made of copper, stainless steel, or other alloys. The units are fabricated with single or multiple corrugations, and with flanged or welding ends. Units with stainless steel inner liners, tie rods and special flanges and welding combinations are also available.



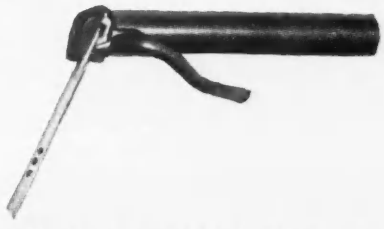
For additional information, write Chicago Metal Hose Corporation, Expansion Joint division, 1306 South Third Avenue, Maywood, Ill.

251—Electrode Holder

A new insulated electrode holder, the Lincoln LJ-1, combines the features of both tong and hole type holders in providing a strong electrode grip, yet easy thumb pressure electrode release.

Tip of the jaw end of the holder is covered with a high temperature resistant, flexible asbestos base compound. Handle and jaw lever are also completely insulated, covered with a tough high temperature fibre. The metal frame is a high strength electrical bronze.

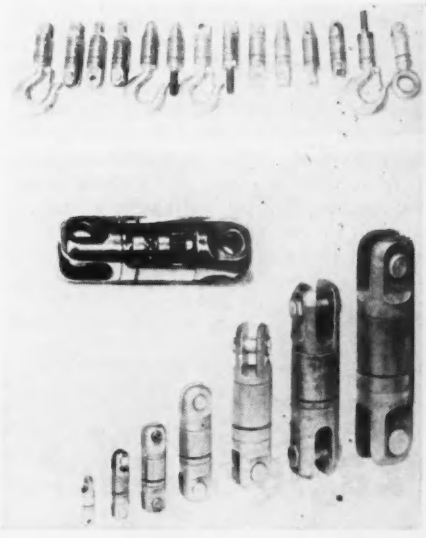
The holder is made in the 250 ampere



size for 1/16- to 3/16-inch electrodes.

For additional information, write The Lincoln Electric Company, 12818 Coit Road, Cleveland, Ohio.

252—Swivels

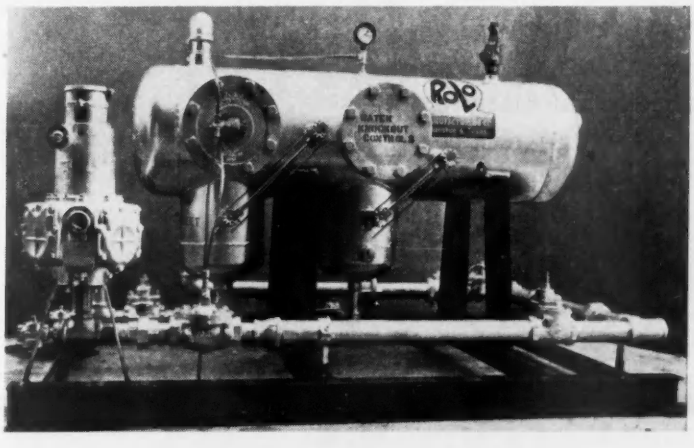


A strengthened line of Miller swivels for eliminating wire line twist and kinking consists of 15 different types of end connections and nine swivel capacities ranging from the "AA" model rated at 250 pounds working load, to the "H" model at 46,200 pounds working. All have a safety factor of 5 to 1.

For additional information, write General Machine & Welding Works, Pomona, Calif.

ROLO WELLCHECKERS

NEW LOW-COST OIL AND GAS SEPARATOR



Rolo No. 4—1H-1604 - Skid or Trailer Mounted

This unit has a separator 16" x 4' x 125# w.p., API-ASME code-labelled to handle prorated wells and small strippers. It efficiently handles from 5 to 500 bbls. per day with a maximum of 200,000 cu. ft. of gas. May be equipped with automatic water knockout, where free water is prevalent. Designed to sell for considerably less than $1000 (completely piped with oil meter), this unit enables the operator to check his well production daily and to secure accurate records for royalties and taxes. Rolo Wellcheckers are made in all sizes to fit any operation. See Composite Catalog or write for illustrated Bulletin.

Oil Well Metering Specialists

ROLO MANUFACTURING COMPANY

BRANCHES: Corpus Christi, Midland, Kilgore, Tulsa, New Orleans, Casper, Edmonton, Alta.

EXPORT OFFICE: R. S. Stokvis & Sons, Inc., 17 Battery Place, New York, N. Y.

253—Tilt Trailers

New tandem axle semi-trailers with tilting platforms are available in 13, 16 and 20-ton capacities. The trailers may be loaded by one man, without use of skids or blocks, by unlocking the safety catch to tilt the platform, driving the equipment onto the platform which returns to level position, and locking catch. Two double-acting hydraulic cylinders cushion the 96-inch wide trailer platform while it is being tilted.

For additional information, write La Crosse Trailer Corporation, La Crosse, Wis.

254—Paraffin Remover

Paraffin accumulation in the piping systems of producing wells, often the cause of major maintenance expense, can be dislodged by means of the Kinney plug injector method. The system includes the Kinney valve, installed on the line near the well, and the soluble plug, injected into the valve at frequent intervals, as necessary.

The valve, or plug injector, is made in

sizes from 1 to 3 inches for low pressure and high pressure, and larger sizes on special orders. While inserting plug into valve, oil can still flow due to the 1-inch bypass built into the valve, which equalizes pressure and eliminates necessity of shutdown time. By a turn of the handle, the flow is directed through the valve and down the tubing, pushing the plug through the paraffin zone. The wax dislodged by the plug is then pumped out with the production oil.

For additional information, write Kinney Machine & Manufacturing Company, Inc., P. O. Box 3426, Odessa, Texas.

255—Scarifiers

Back rip scarifiers, mounted on the back side of bulldozer moldboards, rip the ground when the tractor backs up and float on top of the ground when moving forward.

A set of scarifiers consists of 4 curved shanks capped with lock-on replaceable teeth, each mounted in a separate housing welded to the back of the moldboard. They are available for all standard straight blade bulldozers.

For additional information, write Preco Incorporated, 6300 East Slauson Avenue, Los Angeles, 22.

Eagle-Picher Lead Wool

Stops bottom water

Prevent costly shutdowns, keep bottom water out of your wells, with effective, economical Eagle-Picher Lead Wool. The fine, flexible strands fill cracks and crevices with a permanent, non-corrosive seal... save you time and money. Packed in convenient 50-pound sacks — easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.

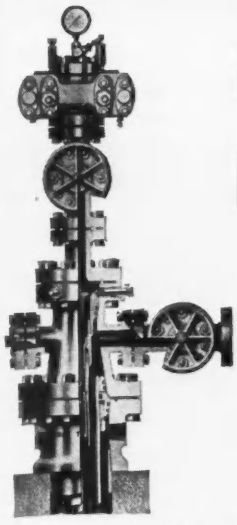
EAGLE EP PICHER

THE
EAGLE-PICHER
SALES COMPANY
Since 1843
Metallic Products Division, General Office
Box 777, East Chicago, Indiana
Cincinnati · Kansas City · East St. Louis
Dallas · Houston
Member: Lead Industries Association

These 3 Eagle-Picher Bearing Metals meet most requirements

1. **Dreadnaught** — for extreme speed and heavy-duty conditions.
2. **Outiasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

GRAY SYSTEMS OF WELL CONTROL INCLUDE THESE DEVELOPMENTS



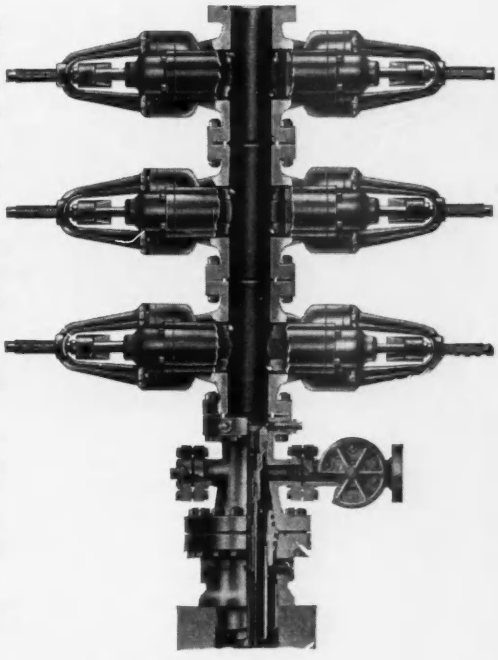
PATENT NUMBERS
2,082,413
2,117,444
2,150,887
2,241,333
2,043,428
Other Patents Pending

RELATED PATENTS include numbers:
2,241,288
2,148,327
2,207,469
2,485,497
2,442,548
Other Patents Pending

Each feature of an "A.S.A. Series" system of well control is measured by, and must qualify in accordance with, such essential standards as:

1. Complete control throughout the performance of all operations.
2. The highest degree of simplicity, meaning the fewest number of the highest quality parts. This is the first requisite of safe well control, as hazards multiply in proportion to the number of parts used.
3. The minimizing of pressure subject areas, resulting in a proportionate reduction of operating loads. (Strict adherence to this fundamental of hydraulics.)
4. The use of relatively long-lived materials in the permanent flowing structure, especially seals. These seals are the heart of a well control system, the body being merely a housing therefor.
5. The ability to remove for repair or replacement each part when and as it has completed its full operating function.
6. Adapting the whole to the problems peculiar to a given area or a particular company. (That custom touch which is foreign to mass production practices.)

These fundamental standards are an inexorable part of each Gray Well Control study. Consistency in rigidly adhering to these standards looks toward the development of advantages while avoiding disadvantages which so often accompany inconsistent change. (A balanced structure.)

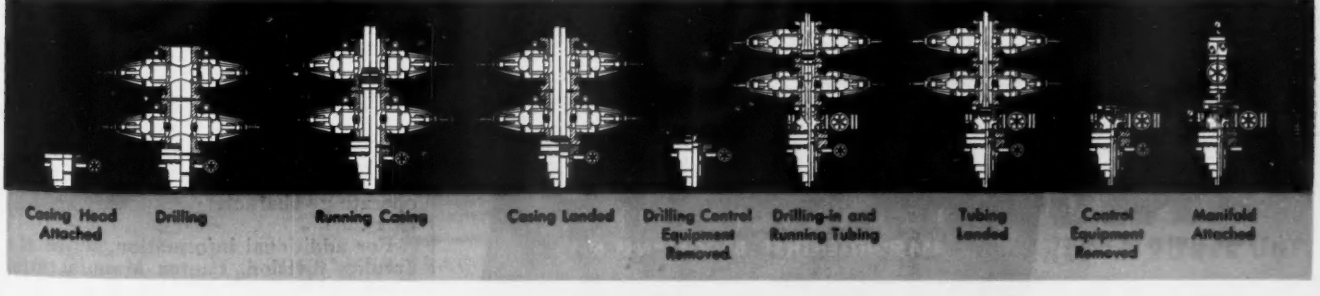


It goes without saying that a standard has no meaning except when measured by the equipment and practices established as being the measurement by which other equipment is to be weighed.

Gray Patented Systems of Well Control have been weighed, accepted, and published by the American Petroleum Institute as its Standard of Excellence for the measurement of other equipment and practices.

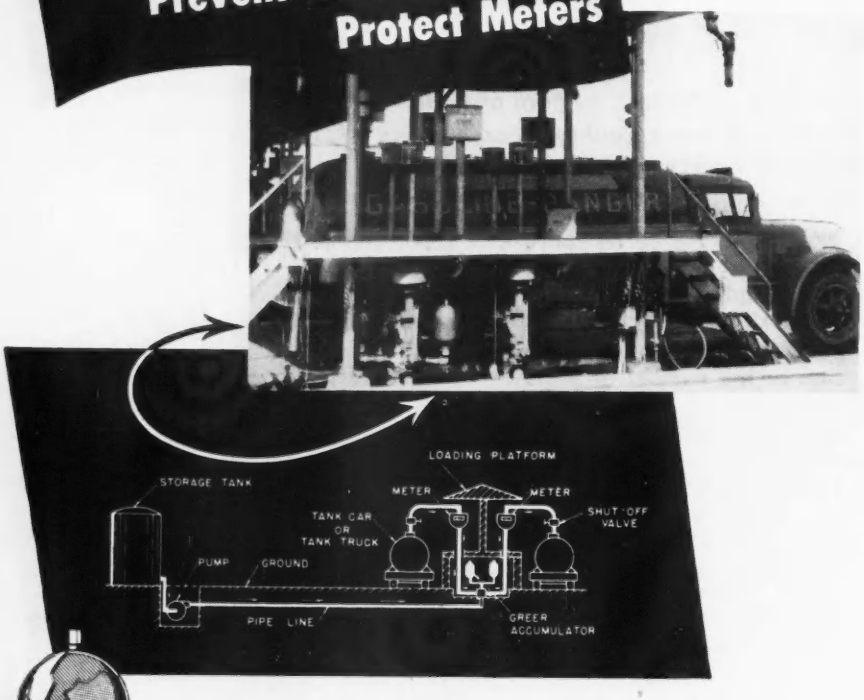
GRAY TOOL COMPANY
HOUSTON

Rocky Mountain Representative: CARL MOULDEN, P. O. Box 1890, Casper, Wyoming



GREER ACCUMULATORS

Suppress Line Shocks – Prevent Line Breakage – Protect Meters



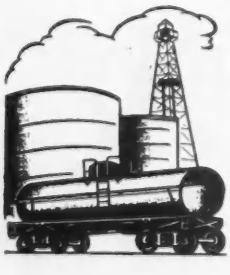
United States Patents Under Oleor Licenses

THOUSANDS of bulk stations throughout the nation are used in the distribution of petroleum products such as gasoline and fuel oil for local consumption.

A typical bulk station is shown above and consists of a series of storage tanks and loading racks. Due to the highly inflammable nature of these products, the storage tanks must be located at considerable distances from the loading racks.

Fuel is pumped to the loading truck and when the required quantity shows on the meter the supply is immediately cut off by a quick-acting valve. This sudden stoppage in flow sets up hydraulic line shocks through the system which unless properly suppressed or eliminated often cause damage to meters, and possible leakage or breakage of the pipeline and fitting.

Greer Accumulators in actual installations, one of which is shown above, suppress these line shocks and minimize or in many cases completely eliminate line failure due to hydraulic shock.



If you have experienced line failures you know how costly they can be. An inexpensive accumulator will save you many times its cost in a short period of time.

Our Bulletin 600 describes in detail the use of accumulators to suppress hydraulic shock. Write for your copy today on your company letterhead.

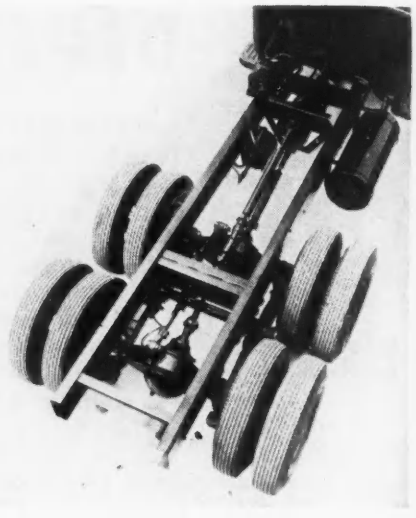
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

YOUR SYMBOL OF SERVICE

GREER
HYDRAULICS INC.
454 EIGHTEENTH ST., BROOKLYN 15, N. Y.

OTHER NEW EQUIPMENT

256—Dual Drives



Center chain drive and dual gear drive units are available for any hauling requirement, on or off the highway.

Center chain drives are available in 5 sizes—for 8, 10, 12, 16 and 20-ton capacity.

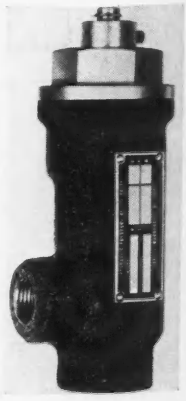
The dual gear drive is made in 3 models. Various gear ratios in the 2-speed power divider, and in the differential, offer a wide range of power and speed.

A complete package unit, the drive can be readily installed on truck or removed for servicing, the manufacturer states. The units are kept in alignment by adjustable radius rods, springs and rollers and pads, and torsionally balanced with brake torque taken through springs and radius rods with little or no weight transfer when brakes are applied. The dual gear drive is pictured.

For additional information, write Cook Bros. Equipment Company, 1815 North Broadway, Los Angeles.

257—Relief Valves

Available for pressure settings ranging from 100 to 5000 pounds per square inch, a new cartridge type hydraulic relief valve opens and closes within a 7 percent differential. Full load shocks and surges do not disturb the valve's "in balance" operation, the manufacturer states.



The valve has been tested through temperature variations ranging from —65° F. to —160° F. with no more than a 5 percent change in operating characteristics.

For additional information, write Hydraulics division, Pantex Manufacturing Corporation, Pawtucket, R. I.

"BEST TRACTOR FOR OIL FIELD WORK"

—says operator Ira Williamson of his International TD-14 crawler.

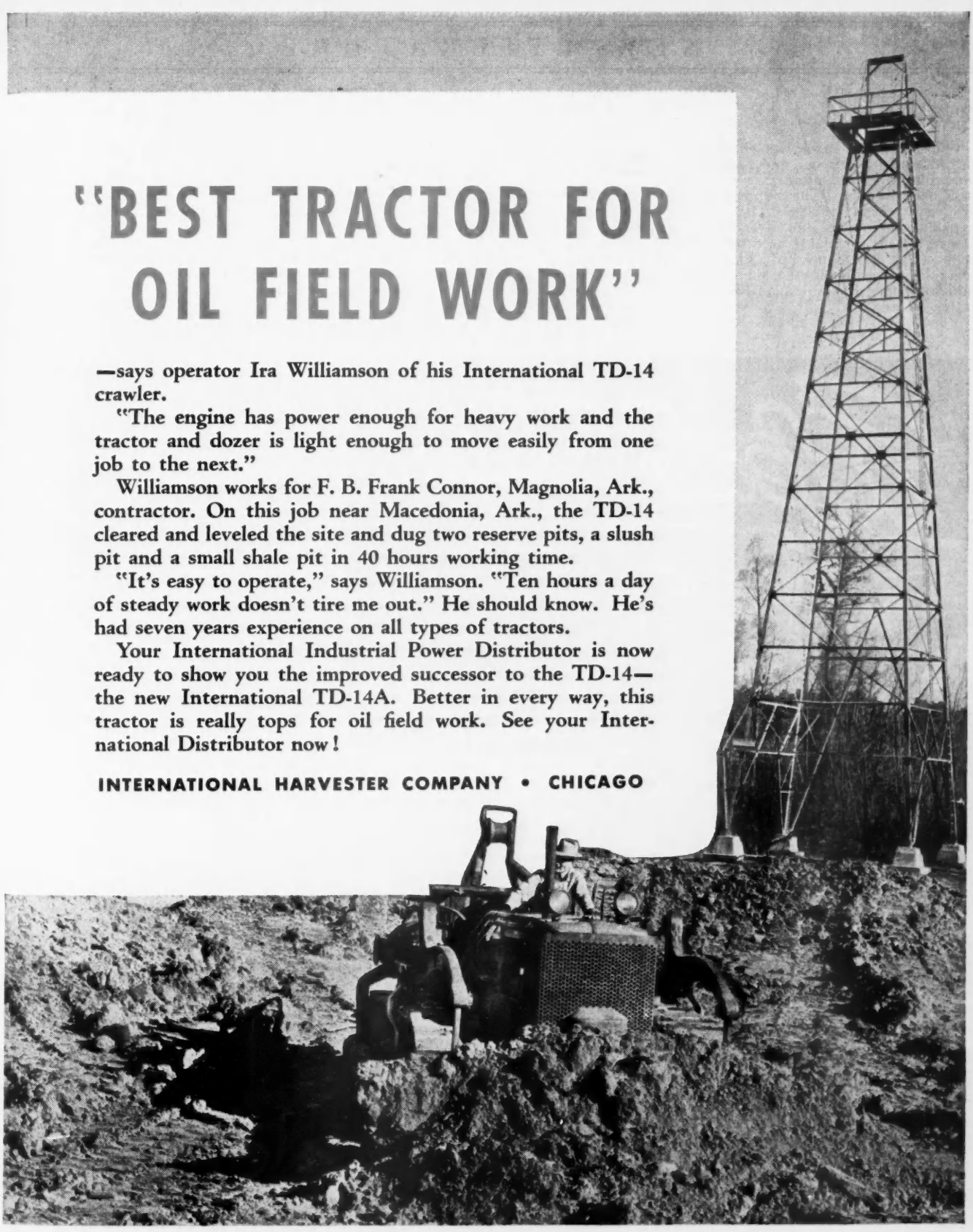
"The engine has power enough for heavy work and the tractor and dozer is light enough to move easily from one job to the next."

Williamson works for F. B. Frank Connor, Magnolia, Ark., contractor. On this job near Macedonia, Ark., the TD-14 cleared and leveled the site and dug two reserve pits, a slush pit and a small shale pit in 40 hours working time.

"It's easy to operate," says Williamson. "Ten hours a day of steady work doesn't tire me out." He should know. He's had seven years experience on all types of tractors.

Your International Industrial Power Distributor is now ready to show you the improved successor to the TD-14—the new International TD-14A. Better in every way, this tractor is really tops for oil field work. See your International Distributor now!

INTERNATIONAL HARVESTER COMPANY • CHICAGO



Standardize on Power that Pays

INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

CRAWLER TRACTORS • WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS

258—Line Shock

Causes of line shock, its characteristics, detrimental effects, and methods of determining its magnitude are discussed in a new bulletin, "The Suppression of Hydraulic Line Shock." The bulletin explains the use of the Greer Hydro-Pneumatic Accumulator as a means for suppressing line shock, provides a formula for determining the size of accumulator required, and explains and illustrates installation.

For a copy of Bulletin 400, write Greer Hydraulics, Inc., 454 18th Street, Brooklyn.

259—Air Clutch

Design, component parts, and the operation of the Ideal Dy-A-Flex air clutch are illustrated in Bulletin I-364. An engineering drawing shows how any Ideal Type 100 drawworks can be converted to utilize the Dy-A-Flex clutch.

For a copy of this bulletin, write The National Supply Company, Box 889A, Toledo, Ohio.

Safe-all the Way
One of a series of typical Propane Truck Loading Racks
CHIKSAN Style 50 x 5 Counterbalance Swivel Joint
OKADEE L. P. G. Valve
WECO Wing Union
WECO Hi-Speed Thread Seal
Eliminate all the weak spots in your L. P. G. loading racks! Use CHIKSAN Ball-Bearing Swivel Joints, WECO Wing Unions, Okadee Valves and WECO Hi-Speed Thread Seal...and get matched safety all the way... plus dependable performance, low maintenance cost, easy handling and long life.
Wherever you handle liquids, vapors or gases through flexible lines, this engineered combination saves you time and money. CHIKSAN Engineers will gladly assist you in designing flexible lines for the safe handling of a wide range of products...in any length...any size...any pressure to 15,000 psi.
WRITE FOR CATALOG NO. 50
REPRESENTATIVES IN PRINCIPAL CITIES
SOLD BY LEADING SUPPLY STORES EVERYWHERE
CHIKSAN TRADE MARK REG.
CHIKSAN COMPANY
AND SUBSIDIARY COMPANIES
Chicago 3, Ill. BREA, CALIFORNIA Newark 2, N. J.
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.
BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

260—Electric Weld Pipe

A new 20-page illustrated booklet contains a complete description of the manufacturing process of electric weld pipe. One section is devoted to structural and mechanical applications.

For a copy of Form ADV-521, write the Advertising division, Republic Steel Corporation, 3100 East 45th Street, Cleveland 27.

261—Tractors

Several new machines added to the "Caterpillar" line are described and illustrated in a new products catalog, Form 12597.

For a copy of this catalog, write Caterpillar Tractor Company, Peoria 8, Ill.

262—Plastic Pipe

A new eight-page, illustrated brochure, "How to Control Corrosion with Carlon Plastic Pipe," shows applications of plastic pipe in the oil fields.

For a copy of this brochure, write Green Contracting and Engineering Company, Inc., 103 South Vine, Wichita, Kansas.

263—Calibrating Tanks

A number of tanks that have not been pictured or described before are included in a new calibrating tank bulletin, No. CT 101-50.

For a copy of this bulletin, write Warner Lewis Company, 817 North Lewis Place, Tulsa.

264—Jacks

Specifications and application information on all sizes and types of mechanical and hydraulic jacks is included in a new 32-page catalog.

For a copy of Catalog 50, write Templeton, Kenly and Company, 1020 South Central Avenue, Chicago 44.

265—Plug Injector

The Kinney method of removing paraffin from flow lines and the injection of the Kinney soluble plug into the Kinney valve are discussed in a new illustrated bulletin.

For a copy of this bulletin, write Kinney Machine and Manufacturing Company, Inc., P. O. Box 3426, Odessa, Texas.

266—Coatings

A paper, "Physical Chemical Research in the Protective Coating Industry," by Dr. Roy H. Kienle, Calco director of application research, is available as Technical Bulletin 901.

For a copy of this paper, write American Cyanamid Company, Calco Chemical division, Bound Brook, N. J.

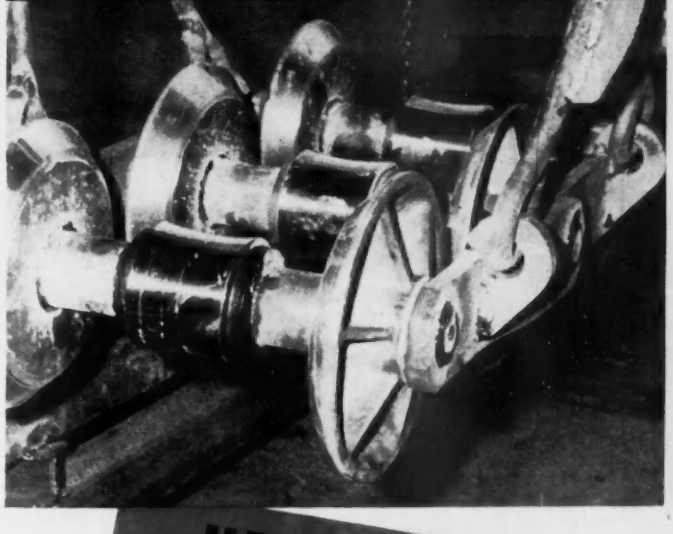
WHEN TESCO CASTINGS REPLACED A WELDMENT,

THE MANUFACTURER REDUCED FIRST COST,

CUT MACHINE TIME 50%, INCREASED BEARING SURFACE 50%

THIS IS THE WELDMENT

THIS IS THE STEEL CASTING



The story of why this manufacturer switched from weldments to steel castings for his pipe line cradles has a moral that can apply to your products, too. Study the facts, at right, of the benefits to the manufacturer from his switch to steel castings. Conversion of some of your products to steel castings may result in equal if not greater advantages. At Tesco there is every modern facility in tools and craftsmanship to produce the very highest quality steel castings for every industrial need.

So before you design a new product or redesign an old one, let the Tesco product engineer help you reduce costs and get into production sooner. Let us show you how Tesco Steel Castings can help you produce stronger, better appearing products.

HERE ARE THE *FACTS*

The following advantages resulted when the manufacturer switched from weldments to steel castings:

1. The finished cast wheel weighed 90 lbs. as compared to 140 lbs. for the finished welded wheel . . . a saving of 50 lbs. per wheel.
2. Cost of the finished cast wheel was less than that of the materials needed to make a fabricated wheel and hub.
3. Bearing surface on the rims of the wheel was increased 50%.
4. The length of the three axles and housing was reduced 4", resulting in other material savings.
5. Castings eliminated all preliminary machining and fabrication on the wheel.
6. Finished product appearance was improved.

TEXAS ELECTRIC STEEL CASTING CO.

GOOD CASTINGS — CARBON AND TESCO ALLOY STEEL — HOUSTON, TEXAS

Men in the Industry NEWS

H. F. Sinclair has been made honorary chairman of Sinclair Oil Corporation, the company he founded in 1916. The action was taken by the board of directors following Sinclair's announcement that he wished to retire under the company's pension plan, and did not desire to be re-elected chairman of the board. He will continue to serve as a director and consultant.

P. W. Thirtle, comptroller, was elected vice president, and **H. Jeffries,** formerly assistant comptroller, was elected comptroller. **S. H. McManus** was named assistant comptroller. **E. L. Wagon,** formerly assistant comptroller, was appointed special assistant to Thirtle.

All other officers were re-elected, **P. C. Spencer,** president of the company, announced.

•

R. S. Fowler, vice president of Aramco Overseas Company, has established headquarters and residence in Rome, Italy. He is the senior resident officer in charge of Aramco Overseas Company's operations in Italy.

•

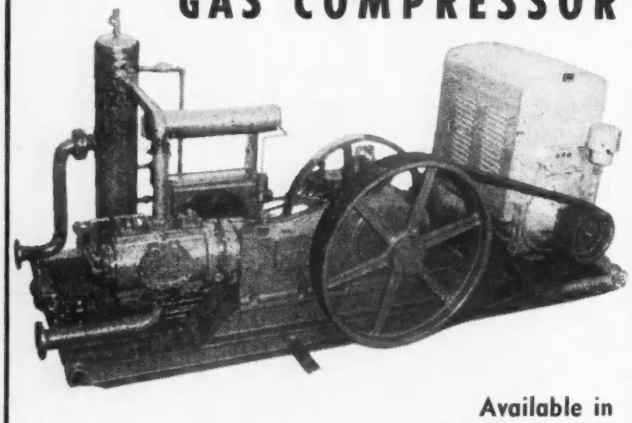
Warren Beebe has resigned as exploration manager for Anderson-Prichard Oil Corporation, Oklahoma City, to become an independent operator and consultant.

Two Freedom Foundation Awards were accepted by H. C. Smith, president, left, for American Oil Company. The company was honored for "outstanding achievements in bringing about a better understanding of the American way of life." Kenneth D. Wells, right, executive vice president of the Foundation, made the presentation.

WORTHINGTON

PORTABLE

GAS COMPRESSOR



Available in
Capacities to 7,500,000 CFM
and Pressures to 1600 Pounds

For your requirements, consult our nearest office or Distributor

A. M. LOCKETT & COMPANY, LTD.

HOUSTON NEW ORLEANS DALLAS

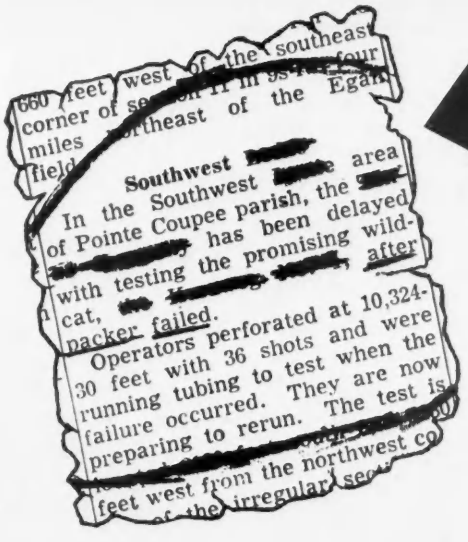
HANDIEST ADDRESS IN PITTSBURGH IS THE **PITTSBURGHER HOTEL**

Singles from $4.00
Doubles from $6.00

400 Rooms each with free radio, bath and circulating ice water. Garage service.

Conveniently located in downtown Pittsburgh, it is quickly reached from highways, railroad stations and airports. In the immediate vicinity are theatres, department stores and important office buildings.

A KNOTT HOTEL
PITTSBURGH 30, PA.
JOSEPH F. DUDDY, MANAGER



Southwest [redacted] area

In the Southwest [redacted] of Pointe Coupee parish, the [redacted] has been delayed with testing the promising wildcat, [redacted] after packer failed.

Operators perforated at 10,324-30 feet with 36 shots and were running tubing to test when the failure occurred. They are now preparing to rerun. The test is [redacted] feet west from the northwest co[rner] [redacted] the irregular sec[tion]

it Costs Real Money to Come out of the Hole at 10,000 ft.

ON THE DEEP ONES RUN

The WILSON

Type "MB"
Metal Block

PACKER

– The Packer That Will Not "Cold Flow"

This Packer was developed with the one purpose in mind . . . to give a perfect "Packoff," regardless of the hydrostatic head.

In the Wilson Type "MB" Metal Block Packer, the packing element cannot "Cold Flow," no matter how deep you are or how heavy the mud. The "Metal Blocks" (shown in red in the illustrations) completely block the element when Packer is set.

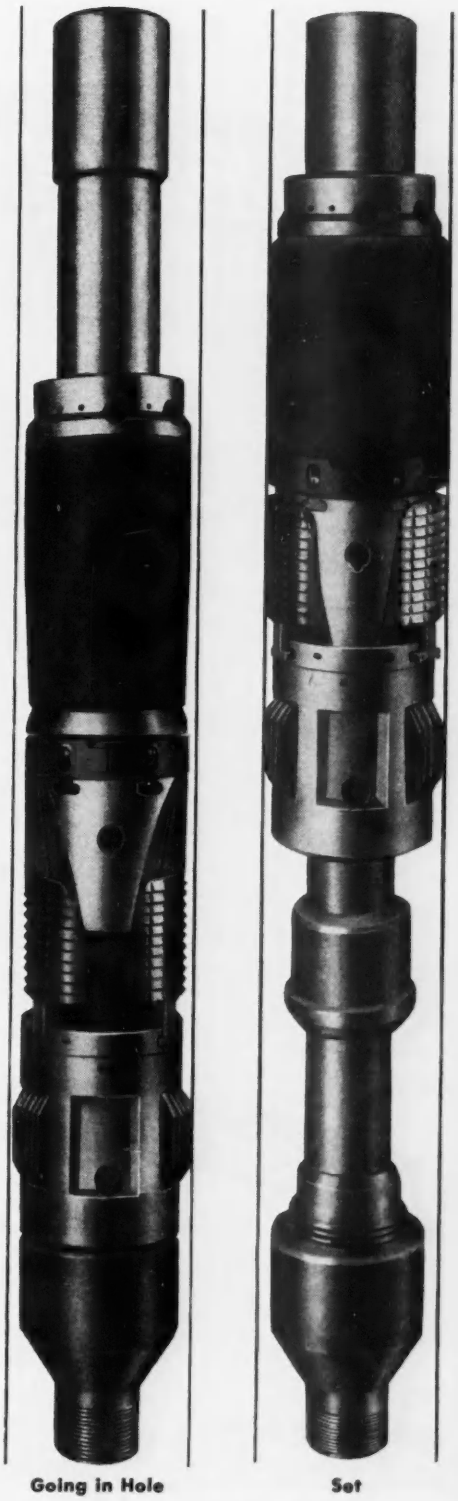
To save time, money and trouble on the *deep ones* . . . run a Wilson "Metal Block" Packer *first* . . . and know the performance will be satisfactory.

●

If your supply store don't have this outstanding Wilson Packer, write:

WILSON FOUNDRY & MACHINE CO.

1417 Elysian Street
HOUSTON, TEXAS



Going in Hole **Set**

Walter E. Caine, O. S. Carpenter, Mills Cox, B. D. Goodrich and **C. L. Brockschmidt** have been named vice presidents of Texas Eastern Transmission Corporation.

Caine, formerly director of the Bureau of Statistics of the American Gas Association, joined Texas Eastern in 1948. From 1940-44 he was assistant chief director of rates and research for the FPC. He is treasurer as well as vice president of Texas Eastern.

Carpenter, company comptroller, joined the firm in 1947. Previously he was in public practice as a certified public accountant in Austin, Texas, and for 5 years served with the Army and governmental agencies.

Cox, who is in charge of gas supply, joined the company in 1948. He had previously been with Penrod Drilling Company in Shreveport, and from 1923-42 was associated with Mills Bennett Production Company in Houston.

Chief Engineer Goodrich joined Texas Eastern in 1947 after 7½ years with United Gas Pipe Line Company as engineer on new construction work.

Before joining Texas Eastern in 1947, Brockschmidt was with Standard Oil Company (N. J.) as a specialist in liquefied petroleum gas. He is now in charge of gas sales.

•

K. H. Crandall has been elected a vice president of Standard Oil Company of California. Since 1947 Crandall has been vice chairman of the board of The California Company, Standard subsidiary operating in the Rocky Mountains and the Central and Gulf Coast regions. He has been a director of another subsidiary, Standard Oil Company of Texas, since 1948.

K. H. Crandall

Crandall joined The California Company in 1925 as an assistant geologist, and subsequently was placed in charge of all geophysical work for that company and Standard of Texas. He became a director and vice president of The California Company in 1942, and president in 1945.

•

J. Skliros, retired managing director of Iraq Petroleum Company, was invested by the French Ambassador in London with the Insignia of Commander of the Legion of Honor.

•

Rodrigo Bastidas M. has joined the producing and consulting firm of Cecil Hagen as a junior petroleum engineer. Bastidas had previously been with the Manabi Exploration Company, Inc., at Guayaquil, Ecuador, and before that with Shell Company of Ecuador in Oriente Province.

•

Dr. Carl S. Kuhn, Jr., Magnolia Petroleum Company, has been named assistant supervisor in the Production Research division of the company's Field Research Laboratory. Dr. Kuhn, who was previously activity leader in charge of research on drilling muds and cements, received his B.S. in chemical engineering from Rice Institute in 1933, and the Sc.D. from Carnegie Institute of Technology in 1937. He has been active in various phases of Magnolia's research since that time.

Dr. Evin L. Cook succeeds Kuhn as activity leader for muds and cements. Dr. Cook obtained his B.S. in chemistry from Baylor University in 1939, and the Ph.D. in physical chemistry from University of Texas in 1949. His background includes research experiences with several major oil companies prior to joining Magnolia early in 1949.

•

Sheldon Beren is manager of Kansas and Oklahoma operations for Omar Oil Company, which has opened offices in Wichita, Kansas.

•

Sam L. Riley, engineer, Cromwell, Okla., station, has resigned from Interstate Pipe Line Company after 30 years' service.

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Pictured is CMC Dual-Prime Model 37 on the job for Sunray Pipeline Company—pumping 80 barrels per hour at Velma, Oklahoma. This general-purpose 3" self-priming pump is widely used for dependable portable operation.
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CMC Dual Prime Oil Field Pumps have unmatched automatic priming speed on suction lifts over 25'—give longer trouble-free performance. Sizes 1½" to 10"—3,000 to 200,000 gallons per hour. Every CMC pump is tested under most severe conditions. For greatest economy and the best all-around pump performance, insist on CMC. Write today. Our qualified engineers are ready to help you.
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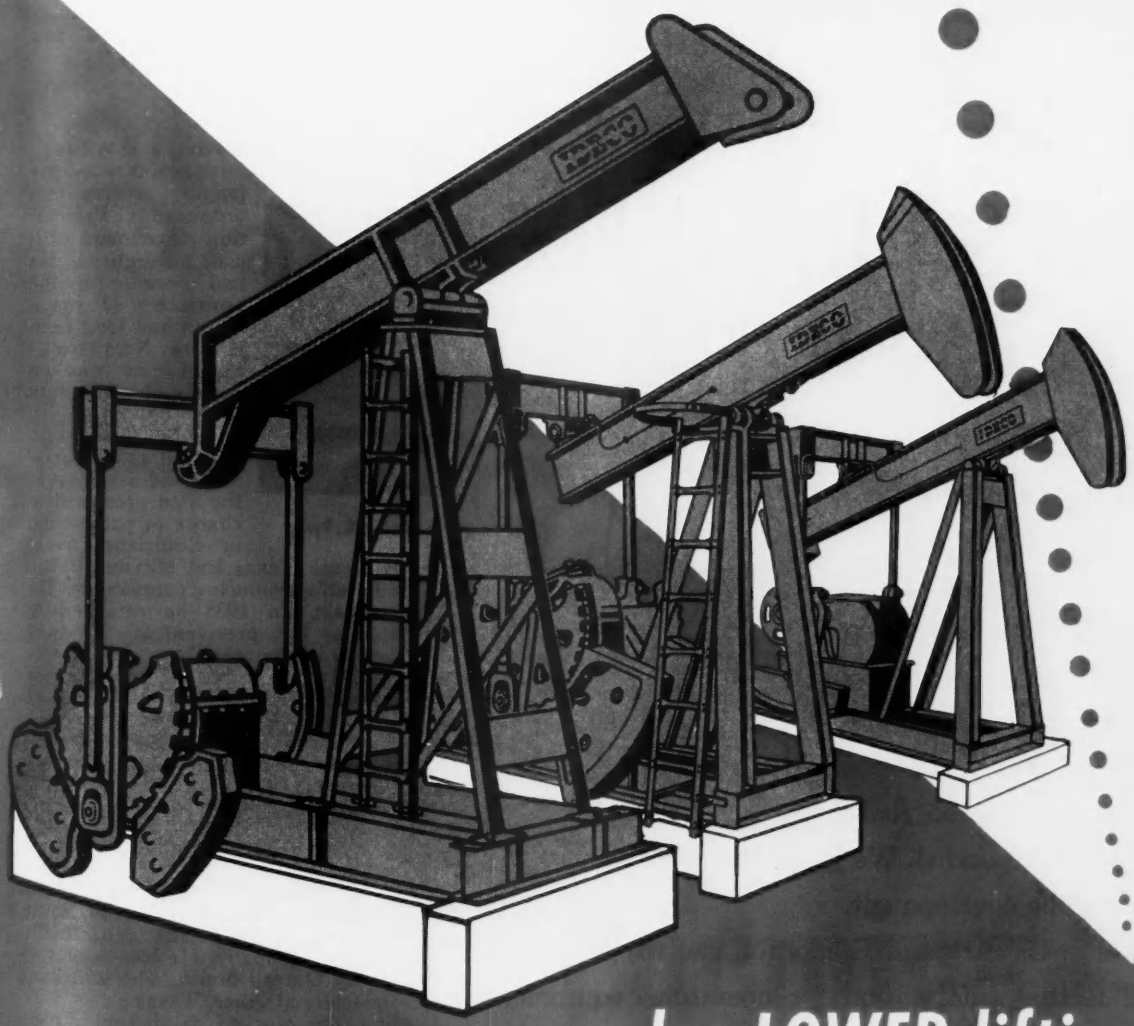
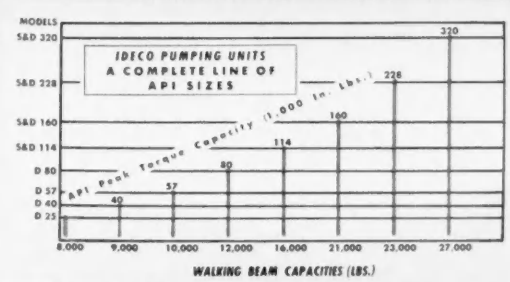


plus LOWER lifting costs



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IDECO
ONE OF THE DRESSER INDUSTRIES

Transfers and Promotions:

R. G. Bechtel, division production superintendent for Stanolind Oil and Gas Company, has been transferred from the Texas-Louisiana Gulf Coast division, Houston, to the Rocky Mountain division, Casper, Wyo. He is succeeded by **T. L. Regan,** formerly division superintendent, Central division, Oklahoma City, who is in turn replaced by **Ken Bolt,** formerly division production superintendent in the Rocky Mountain division. . . . **H. E. Schwartz, Jr.,** district petroleum engineer at Magnolia Petroleum Company's Brownfield producing district, has been transferred to the Chase district as district petroleum engineer, Great Bend, Kansas. **J. P. Schmalz,** formerly district petroleum engineer at Rodessa, Texas, has transferred to Brownfield. **Robert E. Ritchie,** petroleum engineer formerly at Great Bend, has moved to the Kermit district in West Texas. **James F. Mayfield,** petroleum engineer at Rodessa, has been promoted to district petroleum engineer. **Hudie H. Barber** has been promoted to assistant foreman in the Jackson, Miss., producing district.

O. C. Smith, landman, Sinclair Oil and Gas Company, has been transferred from Tallahassee, Fla., to Wichita, Kansas. . . . **J. W. Hudson,** Republic Natural Gas Company, has been transferred and promoted from district superintendent at Pauls Valley, Okla., to general superintendent of oil and gas production at Dallas headquarters. He is succeeded by **C. C. Book,** formerly assistant district superintendent at Pauls Valley. . . . **Nelson H. Newman,** Phillips Petroleum Company, Land department, has been transferred from Ardmore, Okla., to Houston. . . . **Dorsey Hager,** consulting geologist, formerly of Centralia, Ill., has moved to Salt Lake City, Utah.

•

General Walter B. Pyron, a vice president of Gulf Oil Corporation with the longest service record of any Production department official, has retired. He had been with the company 43 years. Pyron had long been in the National Guard, and was on active Army duty from 1940-1945.

Walter B. Pyron

In 1929, after serving Gulf as vice president and assistant to the vice president in charge of production in Louisiana, West Texas, South Texas and Mexico, Pyron headed Gulf's producing company on the West Coast. In 1935 he returned to Houston as vice president in charge of production in the areas in which he formerly had been assistant to the vice president. Since November, 1945, he had been in London for the company and was one of the directors of the Kuwait Oil Company, Persian Gulf producing company jointly owned by Gulf and Anglo-Iranian.

•

E. C. Middleton has retired as district superintendent, Southwest district, South Texas division, Producing department, The Texas Company. He has been succeeded by **Darrell Smith,** who will have headquarters at Alice, Texas.

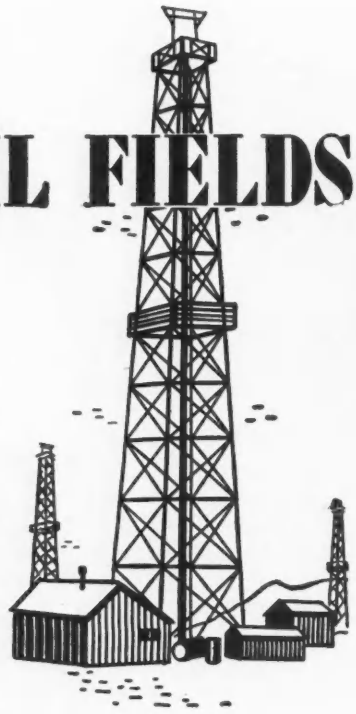
Middleton worked as district superintendent for Lewis Oil Company from 1925 to 1930, when The Texas Company bought out the company's interest in the Southwest district. He remained with Texaco as district superintendent.

Smith received a B. S. degree in petroleum engineering from Texas A. & M. College in 1939, and joined The Texas Company that year. Before his latest appointment, he was assistant district superintendent.

•

Carl A. Houy has been appointed general superintendent in charge of crude oil production in direct charge of all field operations for Deep Rock Oil Corporation, Tulsa. **L. B. Rada,** manager of the Traffic department, succeeds **H. R. Gillespie,** retired. **A. R. Gockel** has been named manager of the Products Supply department.

First in
CANADA'S OIL FIELDS



Alberta today is one of the most active areas of oil exploration in the world with almost double the number of producing wells and output than a year ago. The Royal Bank, with 57 branches in Alberta, opened its branch in the oil field territory in Turner Valley in 1928 and followed with branches in Leduc, Devon and Redwater as development expanded. We know the oil fields and the men responsible for the development.

Our branches in Calgary and Edmonton can supply up-to-the-minute and factual information for operators, equipment manufacturers and all who seek sound advice on establishing connections in Western Canada.

If you have any interest in Canada's oil fields, address your enquiry to:

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Canada's "Oil" Bank

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The Trading Post

PAGE 274

MEN IN THE INDUSTRY NEWS

The New Emblem of Service Pipe Line Company, formerly Stanolind Pipe Line Company, is viewed by J. L. Burke, Tulsa, president of the company, as it hangs on a map of the pipe line system. Largest of the long-line transporters of crude oil, the company adopted the new name to eliminate confusion resulting from the existence of several companies bearing the Stanolind name.

E. C. Borg has been appointed purchasing agent for the Pacific Coast division of The Texas Company. He succeeds **J. T. Rankin**, who has retired after 42 years of service.

Borg joined The Texas Company in 1929 as clerk in the Purchasing department, became Buyer in 1939, and was made assistant purchasing agent in 1949.

Rankin began his business career in 1902 with Westinghouse Electric & Manufacturing Company in Pittsburgh, and remained there until 1908 when he was employed by The Texas Company as chief clerk and cashier at the Houston bulk plant. The following year he was transferred to the Purchasing department.

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BRAND NEW 22 H.P. POWER UNITS *complete with*

Twin Disc Clutch, Impulse Starting Magneto, Enclosure Casing, Governor, etc.

OUR PRICE $235 F.O.B. PHILADELPHIA WHILE THEY LAST!

What a buy...

These are brand new Le Roi engines . . . not war surplus but current factory production with the last word in efficiency refinements. The price speaks for itself. An outstanding opportunity to get thoroughly modern and efficient power units at a ½ price saving! We will gladly send specification data but suggest you order sample engine today.

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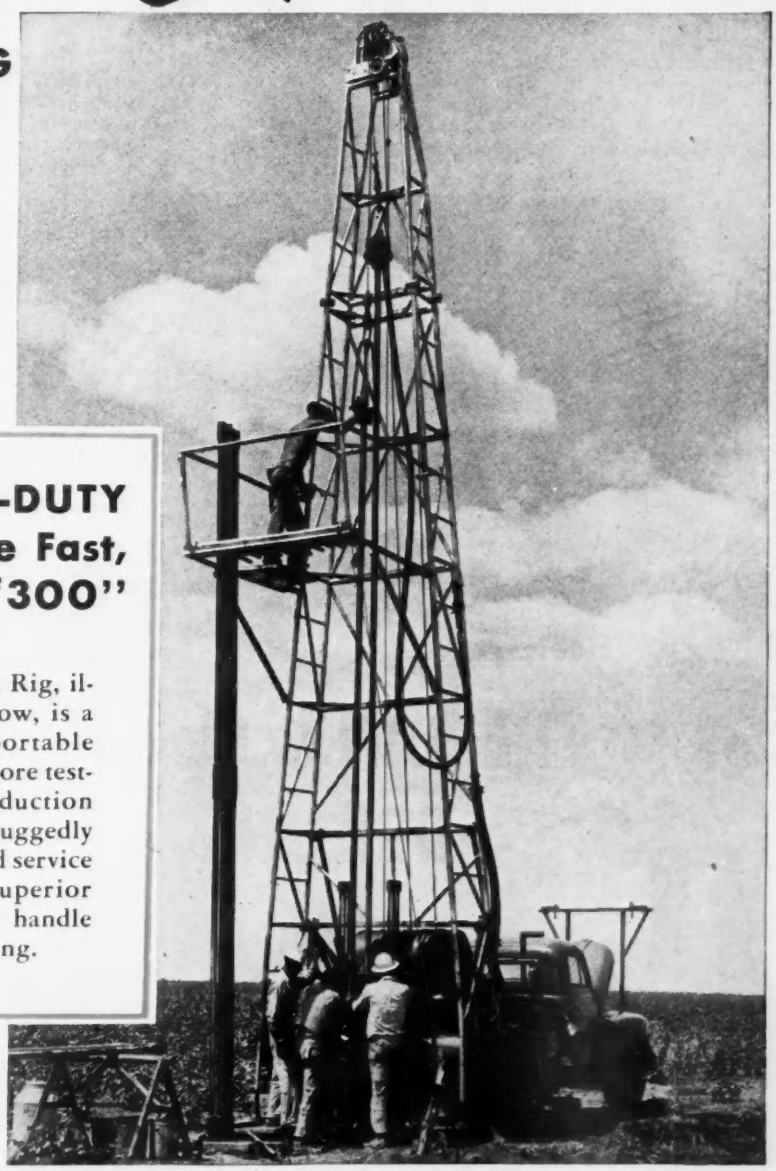
JOY MOTORIZED RIGS

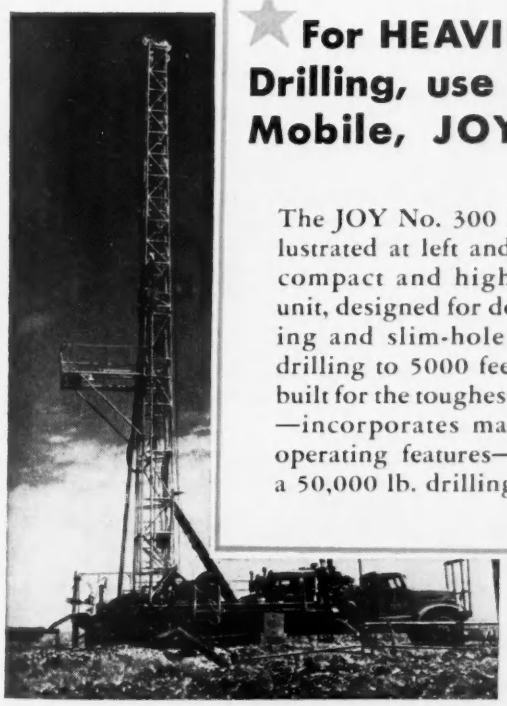
Meet any drilling requirement

★ The NEW "150" DRILL RIG

Latest Design—Top Performance!

The JOY "150" (*right*) is designed for heavy-duty seismograph, electrical logging, structure testing and shallow water well drilling to 1500 feet. It incorporates the most modern improvements in drill rig design . . . has *proved* itself outstanding in the field within its capacity range.





★ For HEAVIER-DUTY Drilling, use the Fast, Mobile, JOY "300"

The JOY No. 300 Drill Rig, illustrated at left and below, is a compact and highly portable unit, designed for deep core testing and slim-hole production drilling to 5000 feet. Ruggedly built for the toughest field service—incorporates many superior operating features—will handle a 50,000 lb. drilling string.

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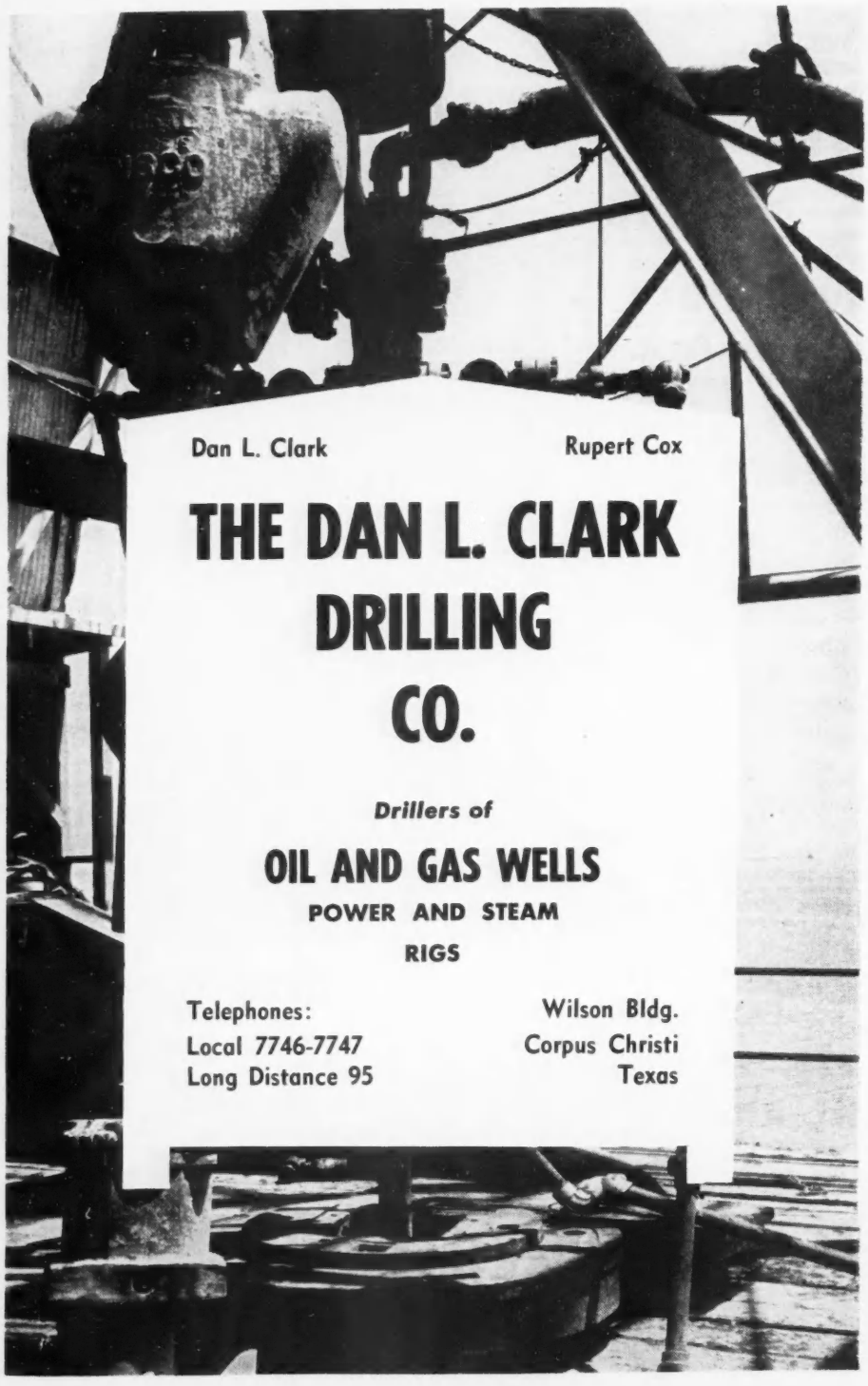
F. W. Krug has been appointed manager of operations for Pan American Pipe Line Company, Houston. Other appointments include **J. F. Chapman** as general superintendent, **W. H. Bruyere, Jr.**, as acting chief engineer, **J. H. Freeman** as purchasing agent, **B. F. Netherland** as superintendent Payroll and Personnel department, and **C. H. Martin,** master mechanic, all with headquarters in Houston.

Milton Crow has been named district superintendent of the West Texas division, with headquarters at Snyder, Texas. Other personnel at Snyder are **Harry G. Egle**, division foreman, **Richard Lenczewski,** division clerk, and **Hall C. Hagler,** connection foreman, all formerly at Alvin, Texas; **Hayne Nelms,** division mechanic, formerly at Douglass, Texas; **J. B. Johnson,** district mechanical engineer, **Leonard A. Dodd,** gangpusher, **J. F. Rogers,** inventory engineer, **Eugene B. McLemore,** senior field clerk, and **John C. Stanley,** senior proration clerk, all formerly at Kilgore, Texas.

•

Delbert Costa has resigned as geologist for The Superior Oil Company, Oklahoma City, and has joined the W. L. Hartman interests at Wichita, Kansas.



C. Henry Austin, for 25 years an attorney in the Law department of Standard Oil Company (Indiana), has been appointed manager of the company's new Insurance department. The insurance department will be under the general supervision of **R. J. Lindquist,** financial vice president, with Austin reporting directly to him.

C. Henry Austin

A graduate of Washington University School of Law at St. Louis, Austin did general trial and corporation work with a Chicago law firm before joining Standard Oil Company (Indiana) in 1924. As attorney in Standard's law department at Chicago, he has represented the company in many fields in the general practice of law.

•

F. J. Adams of Fort Worth, **B. C. Belt** of Houston, and **P. H. Bohart** of Tulsa have been elected vice presidents of Gulf Oil Corporation.

Adams' service with the company began in 1910 soon after Gulf opened a production office in Shreveport. Subsequently, as exploration and production activities in North Texas expanded, he was transferred to that area. Since 1924 he has been general agent in Gulf's Fort Worth offices in charge of the company's production activities in North Central and West Texas.

Belt, who for the past several years has supervised the company's geological activities in the Gulf Coast and Southeastern states, was engaged by the company as a geologist in Mexico in 1916. After World War I he was transferred to the Fort Worth office as chief geologist for that area. Most recently he has been chief geologist and assistant to the vice president of the Houston Production division.

Bohart joined Gulf in 1919 as a field geologist in Texas. He was later transferred to Mexico and was in charge of Gulf's activities in that country before his transfer to Tulsa in 1934. In Tulsa he has been assistant to the vice president.

•

H. E. Treichler, Jr., joined the Houston Oil Company of Texas as general superintendent of field operations. Treichler was graduated from the Colorado School of Mines in 1940 with the degree of petroleum engineer, and during the past ten years has been associated with The Texas Company in its field operations. He is an active member of AIME and API.

•

R. S. Stehr, formerly chief geologist, Mid-Continent division, Seaboard Oil Company of Delaware, has been appointed manager of exploration. **J. M. Clayton** has been named assistant chief geologist. **J. W. Rawley** has been named manager of the Land department, with **R. A. Florea,** formerly at Midland, Texas, as assistant at Dallas.

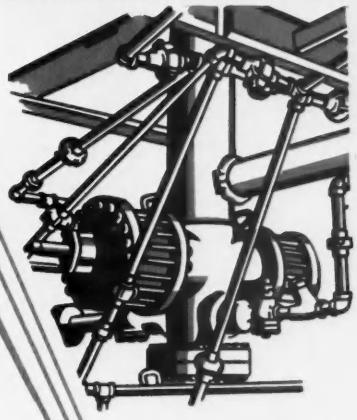
Relieve the Strain with

UNIBOLT FLEXI-BALL JOINTS

ROTARY HOSE—
STANDPIPE END

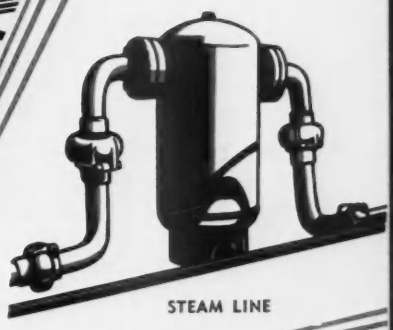
ROTARY HOSE—
SWIVEL END

MUD LINES

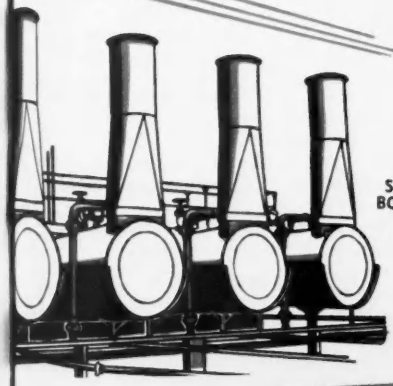


PRESSURE OPERATED
BLOWOUT PREVENTER
MANIFOLD

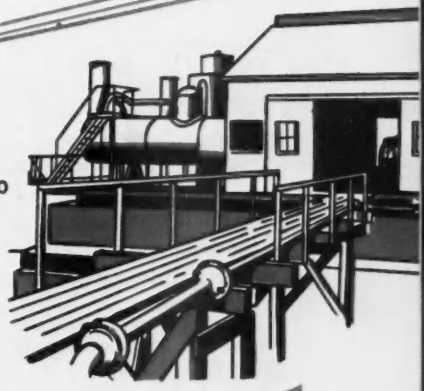
STEAM LINE
SUBJECTED TO
VIBRATION



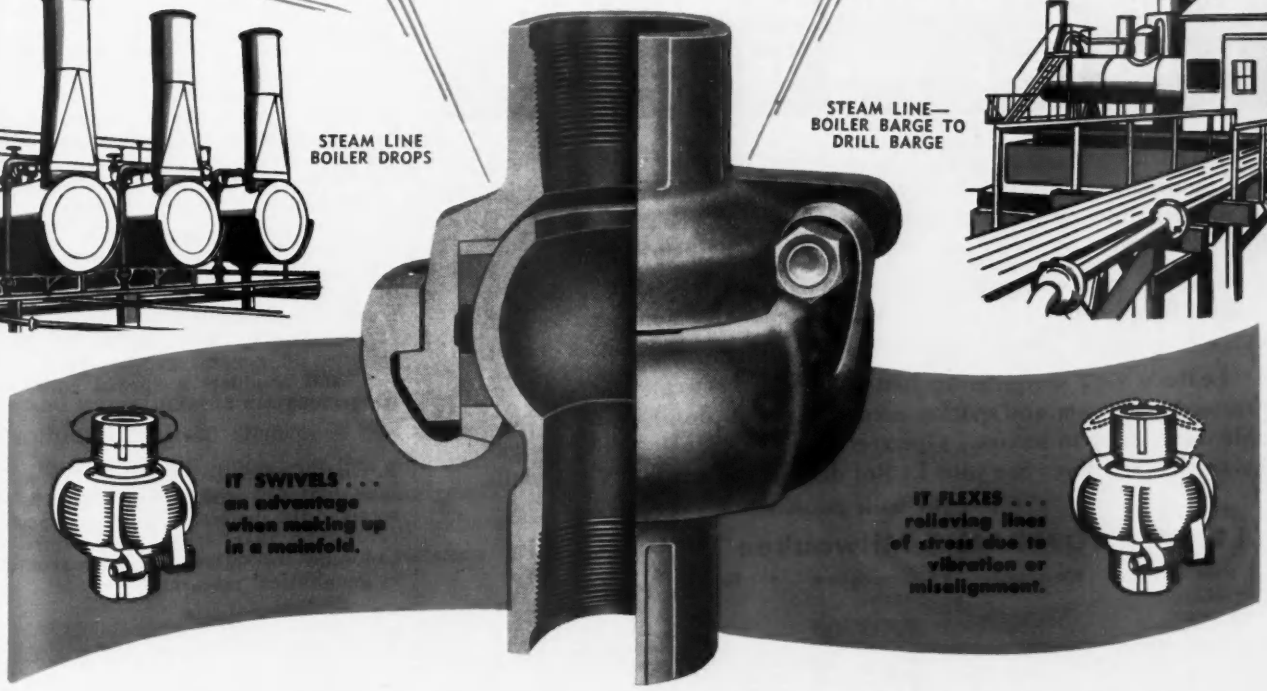
STEAM LINE



STEAM LINE
BOILER DROPS



STEAM LINE—
BOILER BARGE TO
DRILL BARGE



The Flexi-Ball Joint, which provides for misalignment up to 38 degrees, depending on the size of the joint, is designed to relieve piping of stress caused by expansion, vibration, or misalignment. It is a "natural" for flexible manifolds.

The proven UNIBOLT coupling principle is employed to join the component parts of this fitting. As a result, trouble due to galling and freezing of threads is entirely eliminated by the Flexi-Ball design. It is assembled by the simple process of tightening one bolt with an end wrench. Even after extended periods of service, the joint can be quickly dismantled by releasing the bolt.

This fitting may be used safely in any service, since it is made in steel only. Its sizes range from 1½" to 6" and test pressures to 6000 lbs., depending on size; 500 lbs. steam working pressure.

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Hair-trigger acceleration plus plenty of lugging power means faster round trips!

1200 HP at work for Geier-Jackson, Inc. drilling the Montgomery No. 1, 15 miles southwest of Ozona, Texas.

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WHEN it comes to hoisting, you can't beat the wide range of speed and flashing acceleration of the Le Roi L3460. The L3460 with its modern integral V-12 construction guarantees you better than 500 hp at 1350 rpm — more power than any other engine of its kind.

And for mud-pump service the L3460 delivers ample power — from 225 hp at 900 rpm to 450 hp at 1200 rpm. You can count on extra-long engine life at these conservative continuous-service speeds.

Le Roi's V-12 design is unquestionably the answer to demands for greater horsepower and quicker acceleration in a single, compact portable unit. Easy to service. Operates on oil-field fuels — natural gas, butane, or gasoline. See your Le Roi distributors for complete details.

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Kansas
Carson Machine and Supply Co.—Great Bend

Illinois — Western Kentucky
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

Michigan
Hafer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Colorado.

Northern Louisiana & Mississippi
Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

West Coast
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

Appalachian Area
P. C. McKenzie Co., Pittsburgh

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

Complete Sales and Service Facilities P-101

MEN IN THE INDUSTRY NEWS

The Vermilye Medal was presented to J. Howard Pew, left, Sun Oil Company director and former president, by Richard T. Nalle, president of the Franklin Institute, Philadelphia. The award is made biennially by the Institute for "notable leadership in the field of industrial management."

R. P. Lennart, former executive assistant to general manager **J. R. Polston**, Service Pipe Line Company, Tulsa, has been promoted to supervisor of Oil Movements in charge of the department. The new department was created to coordinate oil movement through the company's 10-state pipe line system. **E. E. Hurley**, planning engineer, was promoted to Lennart's former post. **S. N. Williams**, former oil accounting section head, was named assistant supervisor of the new department and **J. D. Behling**, oil traffic engineer, was made oil movements engineer.

•

Heli Badoux, formerly senior geologist for S. N. REPAL Algeria, has been appointed professor of geology at the University of Lausanne, Switzerland. He lectures on general geology, paleontology, and conducts a special course on oil geology.

•

R. Clare Coffin, geophysical coordinator, Stanolind Oil and Gas Company, has received the degree of Doctor of Science (Honoris Causa) from the University of Colorado for outstanding achievements in geophysical research.

•

Russell H. Gwinner has resigned as chief petroleum engineer, Sunray Oil Corporation, Tulsa, to join the oil staff of the First National Bank and Trust Company, Tulsa.

•

D. D. Dellinger has resigned as vice president of Fred M. Manning, Inc., to become an independent contractor, and has organized the Dellson Drilling Company, with headquarters in Denver.

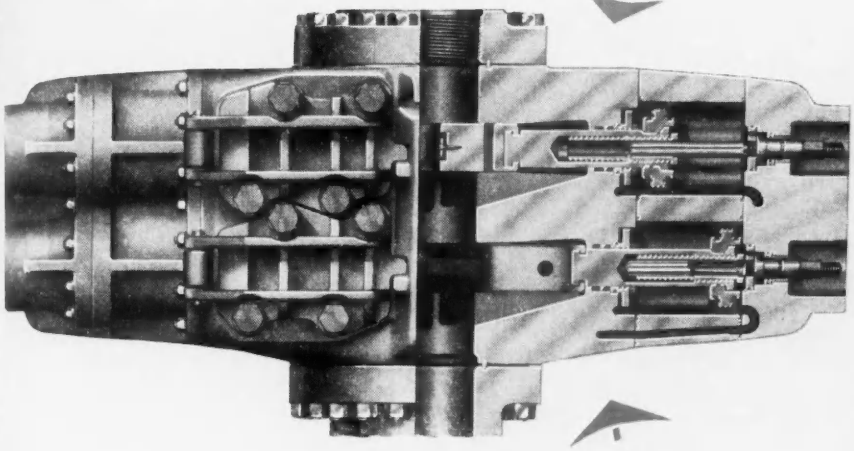
•

Virgil Spradlin, Tulsa, has been named district geologist in charge of The Pure Oil Company's new district office at Wichita, Kansas, with **E. J. Jordan**, landman, and **Jim Smith**, scout.

In the Shaffer Hydraulic Cellar Control Gate

ALL MOVING PARTS ARE COMPLETELY ENCLOSED!

Take a look at the clean design of the new Shaffer Hydraulic Cellar Control Gate. Note how all operating parts are COMPLETELY ENCLOSED within the body of the Gate.



1 There are no outside moving parts to become corroded by chemical muds or salt fluids dripping into the cellar!

2 There is nothing to become wedged or jammed by falling objects or loose timbers in the cellar!

3 There are no exposed shafts where mud and grit can collect to be carried into packing units, score shafts, cause leakage and early failure!

- **No corrosion problems from chemical muds!**
- **No jamming or wedging by loose objects!**
- **Greater protection — greater safety — less maintenance!**

In fact, not only are all moving parts protected within the body of the Shaffer Hydraulic Cellar Control Gate, but even the locking shaft is non-rising and completely protected at all times!

What do these features mean? Simply this—that Shaffer engineers have designed the Shaffer Hydraulic Cellar Control Gate to be safety equipment *of the most advanced type*—with no operating parts exposed to the severe conditions and unpredictable elements found in rig cellars.

Nothing is left to chance. When pressure emergencies occur you can depend on this unit being ready for *fast* and *complete* closure without interference from any foreign material or objects outside the body—*because they simply cannot interfere with its operation!*

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27 YEARS OF OIL TOOL LEADERSHIP

And Don't Forget These Other Vital Features, Too!

Complete protection of the operating parts is only one of many important features found in the Shaffer Hydraulic Cellar Control Gate. These are equally important—

SPACE SAVING COMPACTNESS: Although two separate ram compartments are unitized in *one* body, the overall height of the Gate, including both compartments, is only 30" in sizes as large as 13⅜" (12" Series 900). Smaller sizes even less!

SIMPLE RAM CHANGES—the simplest in *any* Gate. Just unbolt and swing open a side door, slide out the ram assembly, slide in the new assembly, close and bolt the door. It's as simple as that—*and complete ram changes can be made whether pipe is in or out of the hole!*

QUICK DRAINING BODY: The rams travel on high narrow guide ribs raised above the steeply-sloped bottoms of the ram compartments. Mud and sand quickly drain back into the well—no detrimental accumulations to interfere with free ram operation!

DIRECT HYDRAULIC DRIVE: Hydraulic operating cylinders are *directly behind* the rams for direct action, maximum simplicity, greatest safety. No secondary connections between hydraulic cylinders and rams!

And there are still other important features—all combining to make the Shaffer Hydraulic Cellar Control Gate the most advanced *hydraulic* gate available today. Get full details from your Shaffer representative—or write direct!

Write for the new 1950 Shaffer Catalog that gives full information on the Shaffer Hydraulic Cellar Control Gate as well as other Shaffer products.

See pages 4433 to 4496 of your 1950 Composite Catalog!

DEATHS

Thomas A. Creekmore, 54, oil operator and a former director of the National Bank of Tulsa, died in Tulsa June 9. He moved to Oklahoma in 1914 as a roustabout and driller for the old Prairie Oil and Gas Company. He became an independent after World War I and participated in the Burkburnett and Breckenridge, Texas, oil plays before going to Tulsa.

•

Edward B. Heyden, 52, head of Graver Construction Company and vice president of Graver Tank & Manufacturing Company, Inc., died in Cranford, N. J., April 18. He had been with Graver since 1946 and had personally supervised Graver construction projects.

Harry L. Blackstock, 62, pioneer Oklahoma drilling contractor, died May 28 in Oklahoma City.

•

J. O. Turner, 43, Bartlesville, Okla., technical assistant to the vice president in charge of research and development, Phillips Petroleum Company, died May 28.

•

Walter Everett DeYatmett, 80, pioneer Oklahoma oil man, died June 6, in Tulsa.

Albert R. Bradley, 59, retired vice president and assistant secretary of Shell Oil Company, died in San Mateo, Calif., May 14. Bradley received degrees of Bachelor of Laws and Doctor of Jurisprudence from the University of California and saw service in World War I before joining Shell in 1920 as a clerk in the Tax and Claims department. He moved to the Los Angeles office in 1923 as an attorney in the Land department and three years later was appointed head of the Legal department in San Francisco and assistant secretary of the company. He was appointed vice president on June 1, 1944.

•

Fred J. H. Penney, 60, expatriate employe of Lago Oil and Transport Company, affiliate of Standard Oil Company (N. J.), at Aruba, Netherlands West Indies, died May 31, at Frankfort, N. Y.

•

Charles W. Gillespie, 91, pioneer Oklahoma oil man, died June 3 at Turley, Okla. He was lease superintendent for F. A. Gillespie and Sons Oil Company, until his retirement last year.

•

Joseph E. Holveck, 67, hydraulic engineer with Worthington Pump and Machinery Corporation, died May 20 in Montclair, N. J.

•

George R. Probst, 54, manager of Steam Turbine Sales for Worthington Pump and Machinery Corporation, died May 14 in Wellsville, N. Y.

•

Oscar R. Howard, 74, pioneer Oklahoma oil operator and philanthropist, died May 13 in Los Angeles. He had moved to California 30 years ago, but maintained a Tulsa office.

•

Charles H. McDonough, 76, retired Oklahoma independent oil operator, died May 26 in Tulsa.

•

Olin W. Jones, 68, retired independent oil operator, died May 22. He had lived in Tulsa since 1927.

•

William C. Jackson, 45, independent oil operator and general manager of Jackson Materials Company, Tulsa, died May 25.

•

Harry Wade Marker, 63, Tulsa oil tool supply man, died May 22. He was with the Bignall and Keeler Tool Company, Tulsa.

•

Frank Tack, 66, Oklahoma independent oil man, died June 6 in Tulsa.

•

W. J. McGinley, 58, Oklahoma independent oil operator, died May 14 in Tulsa.

•

Samuel C. Lesseig, 63, oil field contractor, died May 13 at Sapulpa, Okla.

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Companies in the News

The 1950 Award for leadership in executive development was presented to Standard Oil Company (N. J.) by R. R. Crow, left, president of the National Association of Training Directors. M. A. Wright, deputy coordinator of producing activities, accepted the plaque in behalf of the oil company.

SUN OIL COMPANY has purchased 42 acres of farm and wood land which will be developed into a recreation center for the use of the Sun Oil Company Employees Recreation Association. The property is on Woodville Road at Millbury, Ohio. An existing 1-story building, 140 by 80 feet, will be converted into a club house.

•

MUDGE OIL COMPANY, Dallas, long identified in oil development in the Southwest, was sold in a transaction which involved more than $8 million.

Ownership of the Mudge Company was acquired by Laird and Company, investment bankers of Wilmington, Del. The Laird firm organized the Christiana Oil Company to negotiate the purchase. A new company, the San Juan Oil Company, has been formed to operate the new properties.

George Weymouth and **Martin Fenton,** partners in the Laird firm, came to Dallas to consummate the transactions which were handled through the Republic National Bank of Dallas.

The San Juan Oil Company will be headed by **Robert J. Bradley,** formerly associated with DeGolyer and MacNaughton. Headquarters of the new company will remain in Dallas.

•

STANDARD OIL COMPANY (INDIANA) technical men discussed subjects ranging from methods of building hurricane-proof drilling platforms in the Gulf of Mexico to methods of making new chemicals from petroleum at the 8th Joint Technical Meeting of the company and its subsidiaries at French Lick, Ind. Attending the week-long meeting were 225 key men. In all, 73 papers were presented.

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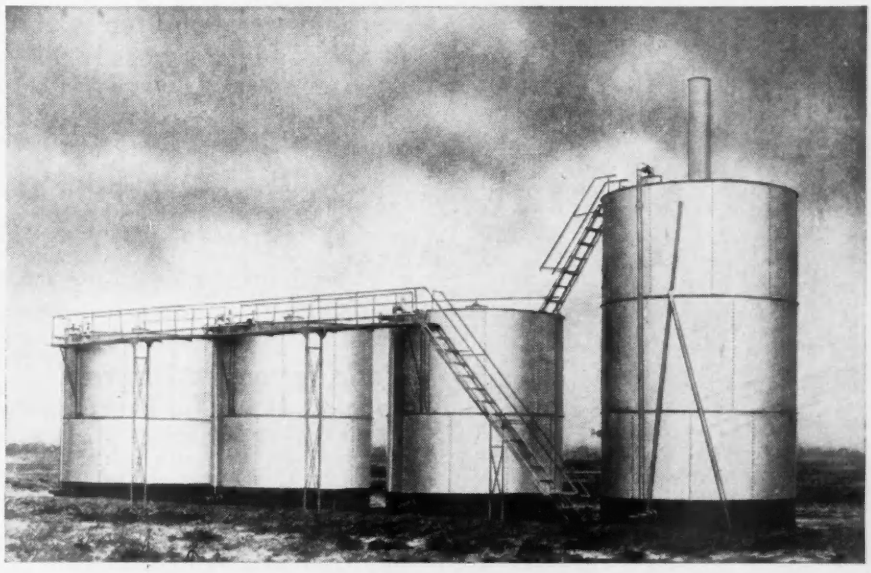

Three 500-barrel Butler Bolted Tanks and one 750-barrel Butler Tank, used by a drilling company of Corpus Christi, Texas.

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•

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RECOVERY

Associations

Information Committee Selects Theme for Oil Progress Week

The Oil Industry Information Committee has selected "Your Progress and Oil Progress Go Hand in Hand" as the central theme for the celebration of Oil Progress Week next October.

The theme will be interwoven in all advertising copy, booklets, leaflets and other literature and materials prepared for the period of October 15 through 21 when the oil industry makes its annual report to the public.

World Petroleum Congress Appoints Honor Committeemen

A Committee of Honor is being formed in connection with the Third World Petroleum Congress, to be held May 26-June 6, 1951, in the Netherlands. The Organizing Committee has addressed invitations to Dutch statesmen and leading figures in the petroleum industry, and international oil leaders.

Papers will be read during the Congress by Professor J. J. Broeze, Royal Dutch/Shell Laboratory, Delft, on "Future Aspects of the Applications of Fuels and Lubricants"; C. Hugel, Institut Francais du Petrole, on "Recent Progress in the Chemistry of Petroleum and its Derivatives"; Dr. C. M. Lees, Anglo-Iranian Petroleum Company, Ltd., London, on "The Oil Fields of the Middle East"; and E. V. Murphree, president of Standard Oil Development Company, New York, on "Benefits from Research to the Petroleum Industry."

Stewart Joins API Staff As Administrative Assistant

Robert H. Stewart, of Hollis, N. Y., has joined the headquarters staff of The API as administrative assistant to the President.

Stewart was formerly with California Texas Oil Company, Ltd., where he had been assistant to the vice president in charge of marketing. Stewart began his career with California Texas Oil Company in 1937. During the early part of World War II, he served with the U. S. Navy Intelligence Service, and in the latter part was assigned as administrative aide to the commanding officer of an LST in the Pacific.

He attended New York University night school and received a B.S. degree in accounting in 1947.

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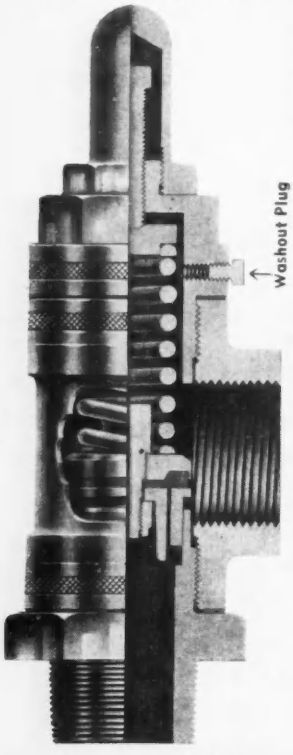

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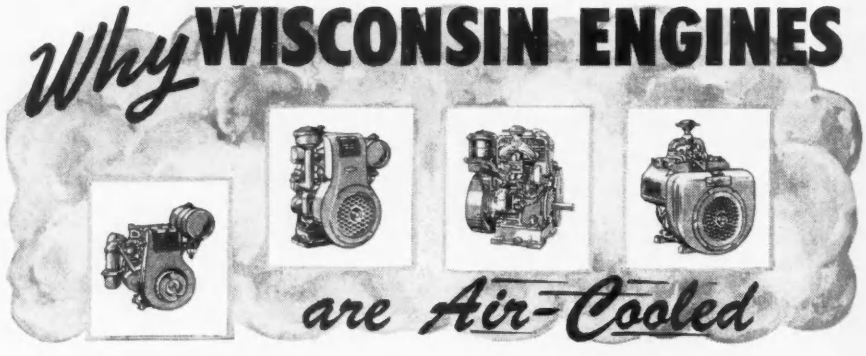

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4. Lighter engine weight and greater compactness . . . for most convenient portability and greatest installation adaptability as power components on original equipment.

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Denver Petroleum Club's last charter membership was presented to Robert F. Six, right, president of Continental Air Lines and an independent oil producer in the Rocky Mountain area. G. F. McMillan, Gulf Oil Corporation, president of the club, made the presentation.

Petrolite Vice President Receives Ohio State Award

Melvin DeGroote, vice president of the Petrolite Corporation, Ltd., Tretolite Company division, and one of the nation's most prolific inventors, was awarded Ohio State University's Lamme Medal. The Lamme Medal is one of Ohio State's highest awards, given annually to a graduate in recognition of "meritorious achievement in engineering or the technical arts."

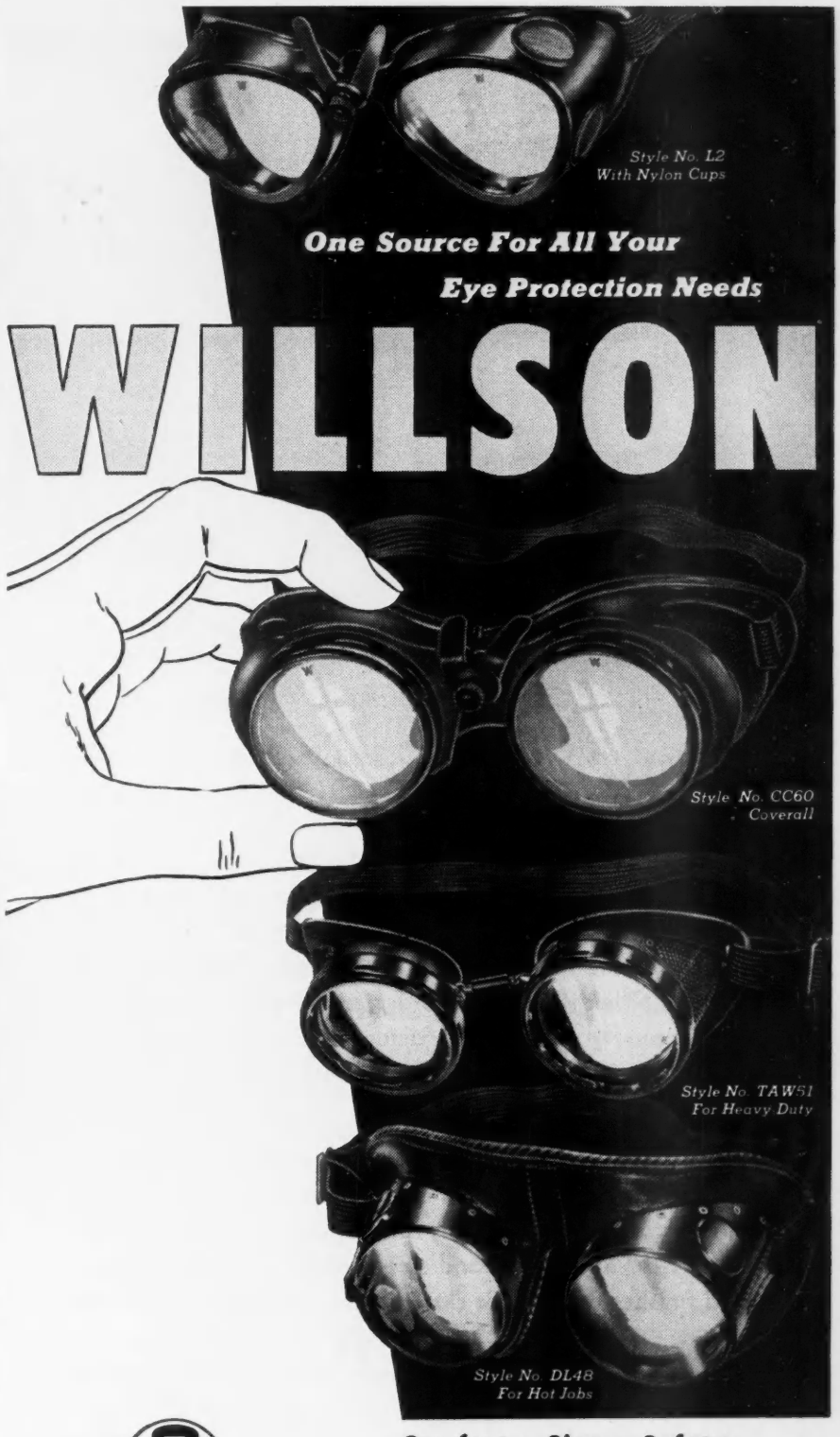
Melvin DeGroote

DeGroote was graduated in 1915 with a B. S. in chemical engineering, and later earned the professional degree of Chemical Engineer. He holds about 518 patents, either as sole or joint inventor, the majority of which are concerned with chemical demulsification and dehydration of emulsified crude oils. He has been affiliated with the Tretolite Company since 1924 and is now vice president in charge of research, development and patents.

In 1941 DeGroote was awarded the Sigma Alpha Mu Achievement award. Since 1930 he has served as a trustee of the fellowship fund of Tau Beta Pi, engineering honor society. He is also a member of Phi Lambda Upsilon, chemistry honor society.

Tulsa Geophysicists Elect

H. M. Thralls, Seismograph Service Corporation, Tulsa, was elected president of the Geophysical Society of Tulsa for the 1950-51 term. Other officers are Paul L. Lyons, The Carter Oil Company, first vice president; Neal Clayton, Republic Exploration Company, second vice president; Robert C. Kendall, Shell Oil Company, secretary; William M. Erdahl, Skelly Oil Company, treasurer.



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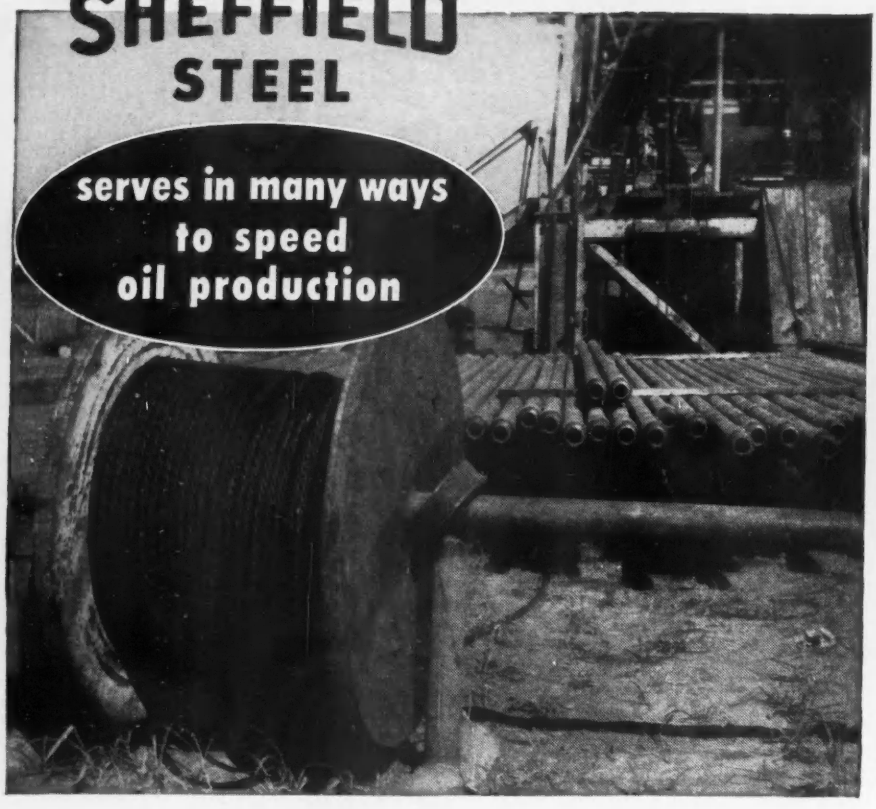
serves in many ways to speed oil production



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ASSOCIATIONS

In Appreciation of services rendered in connection with the Southwestern Gas Measurement Short Course, Dr. W. H. Carson, dean of the College of Engineering, University of Oklahoma, left, received an inscribed plaque and other gifts, at the silver anniversary meeting of the Course held in Norman. C. B. Day, manager, Consolidated Gas Utilities Corporation, is shown making the presentation on behalf of committee members who served with Dean Carson during the past 25 years.

API Luxury Special to Leave Eastern Seaboard November 8

A special train, the "Oil Men's Caravan," will leave the Eastern seaboard November 8 for the 30th annual API meeting in Los Angeles.

The luxury train will leave Chicago at noon November 9 and will allow for visits at Las Vegas, Nev., the Hoover Dam, and Riverside, Calif. The train will arrive in Los Angeles in mid-afternoon November 12.

The train will leave Los Angeles November 16 at 8:30 p.m. with the schedule permitting visits to El Paso and Juarez and the Carlsbad Caverns. Return to Chicago is set for November 20, and to eastern cities, November 21.

For a copy of a brochure containing full details of the trip, write Ralph L. Preble, United States Travel Agency, Inc., 807 15th Street, Northwest, Washington, D. C.

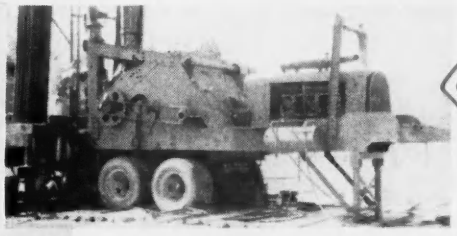
Tulsa Landmen Name Swenson

F. E. Swenson, manager, land department, Deep Rock Oil Corporation, Tulsa, has been elected president of the Tulsa Landmen's Association. Other officers are I. W. Pilkington, Barnsdall Oil Company, vice president; Roy Dunlop, Sun Oil Company, secretary; H. T. Carpenter, The Ohio Oil Company, treasurer. Members of the executive committee are A. L. Chapman, Wilcox Oil Company; Tarz Marsh, The Carter Oil Company; George A. Schwab, Barnsdall Oil Company; G. W. Lackey, Stanolind Oil and Gas Company.

Molett Heads Scout Group

Grant Molett, The California Company, has been elected president of the North Rocky Mountain Oil Scouts' Association. Rex Brown, Gulf Oil Corporation, is vice president, and Sam Bowman, The Texas Company, is secretary-treasurer.

Sure THERE IS A REASON



Model L Single Drum Trailer Mounted skid winch with Cooper 2 pole mast.

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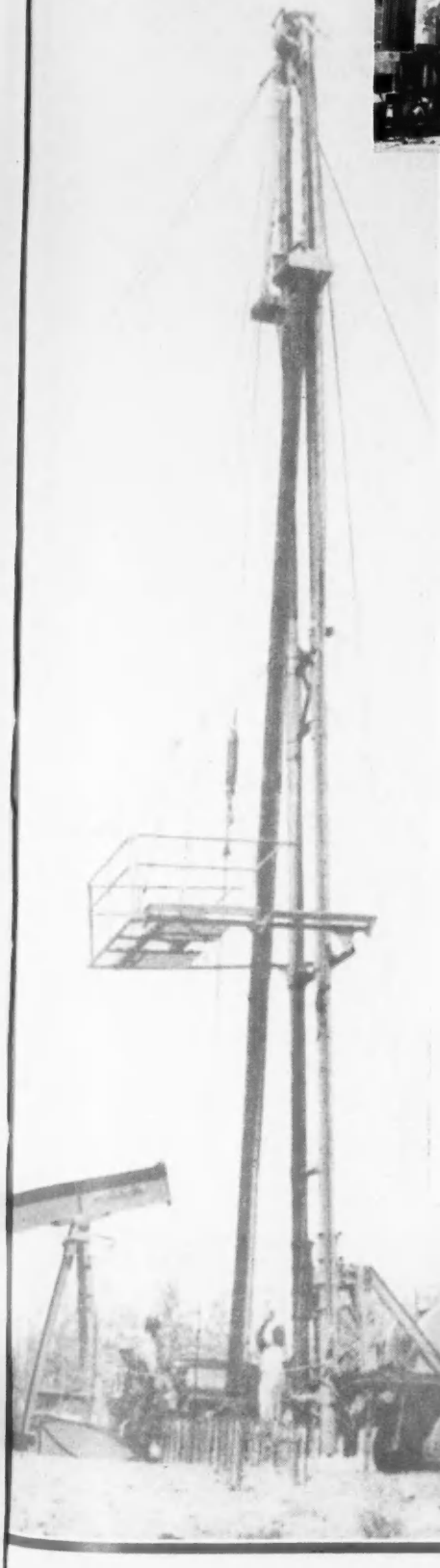
Model E Single Drum winch tractor with Cooper 2 pole mast.



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Model M Single Drum skid winch with Cooper 2 pole mast, rod hanger and tubing rack.

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B — for wells to 1500'
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M — for wells to 4000'
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ASSOCIATIONS

Southwest Institute Appoints Engineering Mechanics Leader

Appointment of C. Desmond Pengelley of Columbus, Ohio, as chairman of Engineering Mechanics for Southwest Research Institute was announced by Dr. Harold Vagtborg, president of the industrial research organization.

C. Desmond Pengelley

Formerly an official of Curtiss-Wright Corporation, Pengelley received degrees from McGill University in Montreal and Massachusetts Institute of Technology.

Pengelley won the British Association Medal for Honors in Mechanical Engineering, a Delta Upsilon Scholarship and a Massachusetts Institute of Technology Graduate Scholarship, as well as an Alfred P. Sloane Fellowship.

Roy Smith Is Chairman of AIME Mid-Continent Section

The Mid-Continent Section, AIME, Tulsa, elected Roy H. Smith, Stanolind Oil and Gas Co., chairman; J. N. McGirl, Tide Water Associated Oil Company, first vice chairman; Jack H. Beesley, Baroid Sales division, National Lead Company, second vice chairman; G. C. McDonald, Gulf Oil Corporation, secretary-treasurer.

J. H. Jennings, The Ohio Oil Company, J. C. McCarthy, Stanolind, and E. S. Wenger, Amerada Petroleum Corporation are new members of the executive committee. H. M. Cooley, Bethlehem Steel Company, immediate past chairman, and J. P. Hammond, Amerada, past chairman, became ex-officio members. Out-of-town committee members include J. R. Hatfield, Cities Service Oil Company, Bartlesville, and D. V. Burrows, Continental Oil Company, Ponca City.

California Producers Elect Cranson Agency President

L. A. Cranson, executive vice president and director of Honolulu Oil Corporation of San Francisco, was unanimously re-elected president of Oil Producers Agency of California.

Cranson, who has headed the organization for the past two years, has spearheaded its recent sponsorship of oil conservation legislation. He is also a director of the Kettleman North Dome Association and a member of many other oil industry groups.

Other officers re-elected by the board are H. E. Woodworth, Safe Oil Company, Bakersfield, first vice president; R. A. Grant, Fullerton Oil Company, Pasadena, second vice president; W. H. Geis, petroleum engineer, Los Angeles, third vice president; C. A. Johnson, Holly Oil Company, Los Angeles, fourth vice president; Rush M. Blodget, executive vice president; W. A. Russell, Seaboard Oil Company, Los Angeles, secretary-treasurer; and Verne Harrell, Bankline Oil Company, Los Angeles, assistant secretary-treasurer.

Bennett Heads Houston Group Of Exploration Geophysicists

The Society of Exploration Geophysicists, Houston Section, has elected Roy F. Bennett, Sohio Petroleum Company, president for the 1950-1951 term. Other officers include J. B. Ferguson, Petroleum Surveys, Inc., and W. C. Kimball, Apache Exploration Company, vice presidents; Eugene W. Frowe, Robert H. Ray Company, secretary; and J. E. (Sam) McGee, Gulf Research & Development Company, treasurer.

Mid-Continent Names Clark

R. W. Clark, Skelly Oil Company, Tulsa, is the new chairman of the Mid-Continent Oil and Gas Association, succeeding M. J. Lasseigne, Arkansas Fuel Oil Company, Shreveport, La. L. E. Frensley, Magnolia Petroleum Company, Dallas, was named vice chairman, succeeding Clark.

Ark-La-Tex Chooses Officers

President of the Ark-La-Tex Geophysical Society, Shreveport, for the 1950-1951 term is Richard Brewer, Atlantic Refining Company. R. B. Baum, Seismograph Service Corporation, is vice president, and B. B. Burroughs, Arkansas Fuel Oil Company, secretary-treasurer.

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and now - the new LYNN HOTEL
101 Air Conditioned Rooms . . . 3405 Gaston Avenue . . . Charles A. Classen, Mgr.

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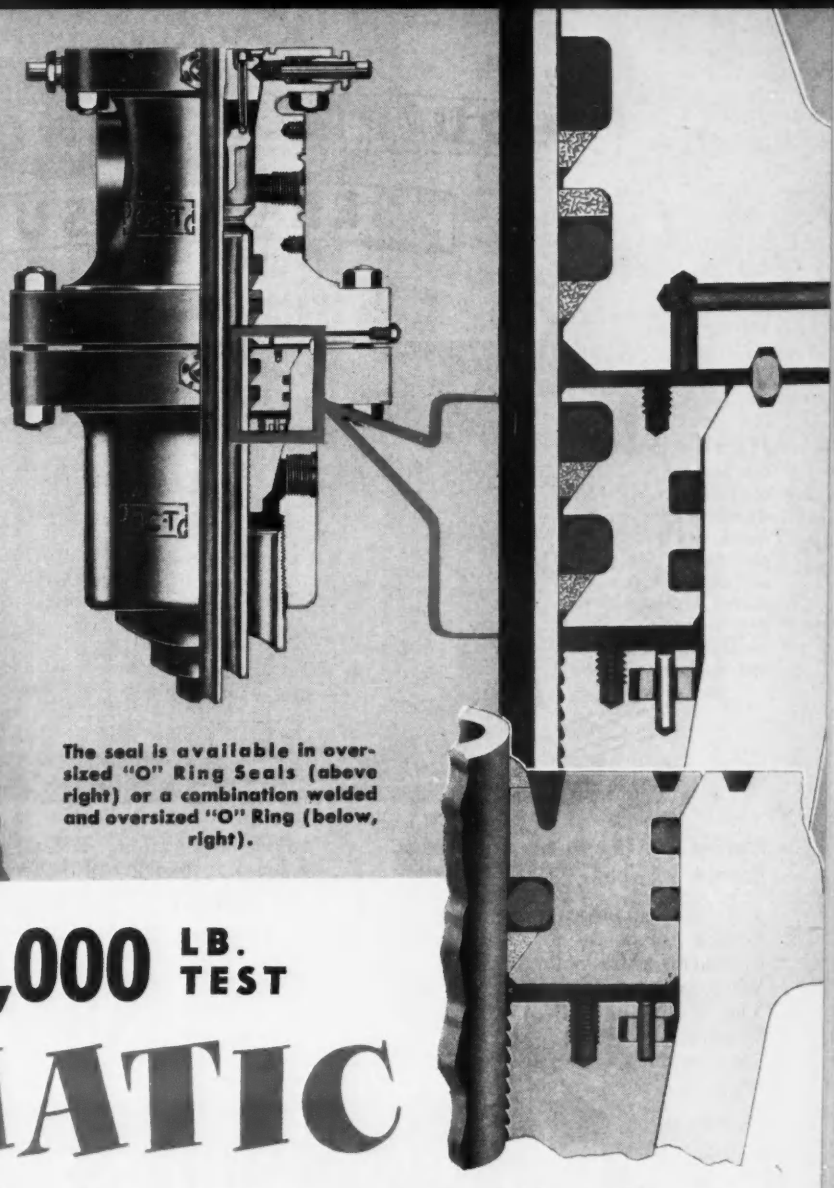

The seal is available in oversized "O" Ring Seals (above right) or a combination welded and oversized "O" Ring (below, right).

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AUTOMATIC FLOATING SEAL

Outstanding among the many features of this new O-C-T "C-18-H" hanger is the design which allows slips and seal to work independently. When a 20,000 lb. test load is applied, for example, the load is applied to the automatic sealing element and not to the slips. This feature removes any possibility of collapsing or crushing pipe with test loads. The test load is applied to the heavy bevel on the body of the head. In addition, Allen screws have been eliminated from the design and well pressure is utilized to equalize the seal all around the pipe. Extra heavy seals are backed up by extrusion rings which conform to the plus or minus API tolerance of the casing. Corrosive gas and fluids are sealed off from the API Metal Ring Gasket between flanges.

Check and compare this new O-C-T "C-18-H" Casing Head with any other head. It provides maximum safety, simplicity and flexibility. Write today for engineering details und prices. O-C-T Products are always dependable and available through more than 700 conveniently located supply stores.

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EQUIPMENT AND SERVICE SUPPLIERS' NOTES

Headquarters for International Derrick & Equipment Company's Executive, Machinery and Export, and Supply Stores departments have been moved to offices in the new Atlantic Building in Dallas, as part of the company's expansion program.

Harley Sales Company Establishes Branch Service Office at Wichita

A new sales and service unit at Wichita, Kansas, has been established by Harley Sales Company, distributor of Wisconsin engines for the oil industry. The firm's other offices are in Tulsa and Houston. Russell A. Pride, who has had considerable experience in pump and engine applications in East Texas and Kansas, is manager of the Wichita office.

Harley Sales Company has been factory distributor for Wisconsin air-cooled engines since 1936. Roy O. Neal, president of the company and founder with his brother, the late Harley B. Neal, has two engineering degrees. He was formerly chief chemist for Cities Service and was a petroleum engineer with the U. S. Bureau of Mines.

President's Assistant Is Appointed By Worthington Pump and Machinery

Charles A. Butcher has joined Worthington Pump and Machinery Corporation as assistant to H. C. Ramsey, president. Butcher was formerly general manager of Crocker Wheeler Electric Manufacturing Company, and vice president of its successive parent companies, Joshua Handy Corporation and Elliott Company. With Worthington, he will make his headquarters at 2 Park Avenue, New York City.

Butcher was graduated as an electrical engineer from Iowa State College in 1915.

Rex E. Galloup Will Head Up Sales For Oil Center Tool at Houston

Rex E. Galloup, former district manager in the West Texas-New Mexico area, has been promoted to sales manager of Oil Center Tool Company and will make his headquarters in Houston.

Rex E. Galloup

Galloup joined the O-C-T sales organization in October, 1946, as a salesman. He was promoted to district manager in the West Texas area in September, 1949.

A graduate of West Texas State College at Canyon, Texas, Galloup formerly was employed by the Natural Gas Pipe Line Company of America, Halliburton Oil Well Cementing Company, and the Orbit Valve Company.

Bovaird Supply Company Transfers Representative to Midland Area

W. J. (Bill) Bovaird has been transferred from Odessa, Texas, to Midland, Texas, as sales representative for the Midland area, according to announcement by Bovaird Supply Company.

W. J. Bovaird

Bovaird has been sales representative of the company working out of the Odessa store for the past year. He previously was stationed at Russell, Kansas.

Perforating Guns Names Mercer

Gayle R. Mercer has been named manager for Oklahoma by Perforating Guns Atlas Corporation, with headquarters at Pauls Valley, Okla. George Decker and F. J. McCaughton have been made field representative at Ardmore and Wewoka, Okla., respectively.

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A FUNDAMENTAL PULSATION DAMPENER

A HIGHER FREQUENCY PULSATION DAMPENER

In 1943, The Fluor Corporation pioneered the development of pulsation dampeners. The first U. S. Patent covering pulsation dampeners designed specifically for the removal of gas stream pulsation and subsequent vibration in compressor piping was issued to Fluor in 1946.

Continued research in gas pulsation and its associated problems has established that pulsation, and its intricate secondary vibration, can be attributed to both fundamental and high frequency pulsations *—or to high frequency components alone.*

Whichever of these destructive conditions exists in your plant, Fluor offers a dampener engineered to fit the requirements of the specific problem. Fluor—and only Fluor—offers such a complete range of pulsation dampeners. For this reason you can be assured of an unbiased recommendation on the best type dampener for your *particular* requirements.

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This type dampener smooths out all pulsations in the gas stream to the extent of at least 85%. All harmonics originally set up in each pulse cycle are automatically reduced or eliminated. This dampener is the guaranteed answer in plants where structural vibration and metering difficulties are encountered irrespective of pulsation frequency.

MAKE YOUR OWN PRELIMINARY SURVEY

In many cases you can make your own preliminary survey to determine roughly if your pipe vibration is caused by pulsations. Write The Fluor Corporation, Ltd., Los Angeles 22, California, indicating layout of compressor house piping and operating pressures. A procedure will be mailed to you promptly. No obligation.

THE FLUOR HIGHER FREQUENCY PULSATION DAMPENER

This dampener removes objectionable pulsation frequencies encountered above the fundamental. In many instances, it has been found that metering difficulties and vibration of compressor piping and nearby vessels have been caused by the higher frequency components alone. Available in both manifold and in-line types, this dampener is competitive in cost with muffler or snubber type devices.

available for your files...

TECHNICAL PAPERS *on the subject of* GAS PULSATION

BY ENGINEERS OF THE FLUOR CORPORATION

"Pulsation Phenomena in Gas Compression Systems"
By: I. C. BECHTOLD, *Director of Research and Development*

Abstract: *Pulsation phenomena in gas transmission lines leading to and from gas compressor stations are described along with a description of the mechanical vibration induced from the pulsative flow.*

"Effect of Pulsation on Gas Measurement"
By: C. F. YATES, *Research Engineer*

Abstract: *This paper discusses the effect of pulsative flow on the accuracy of measuring gas-flow rate by orifice meters. Data are presented showing the relationship between magnitude and nature of the pulse and the resultant readings recorded by the measuring instrument.*

"Mechanical Vibration of Piping Induced by Gas-Pressure Pulsations"
By R. C. BAIRD, *Research Engineer, and* I. C. BECHTOLD, *Director of Research and Development*

Abstract: *The generation and nature of gas-pressure pulses from reciprocating compressor action are described, together with the propagation of such pulses through pipe lines. The means whereby pulse energy is converted to mechanical vibration is discussed by the aid of analogous mechanical, acoustical, and electrical oscillatory systems. The economic importance of minimizing vibration in compressor and compressor-dependent installations is indicated.*

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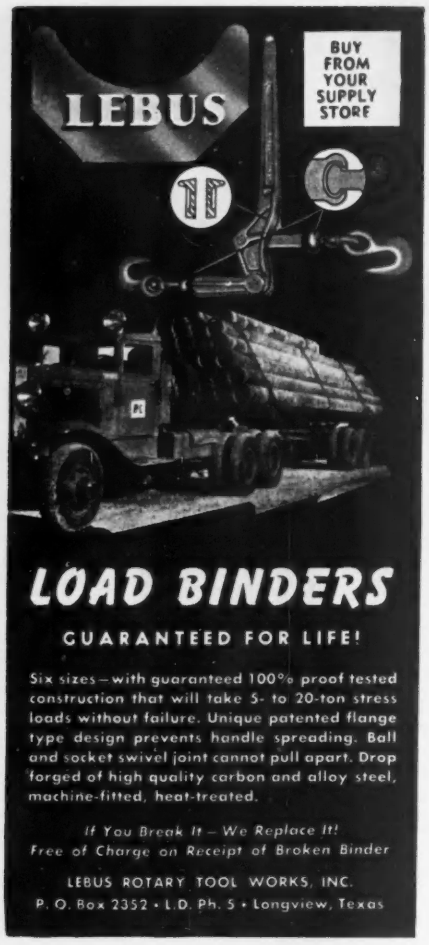
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EQUIPMENT and SERVICE SUPPLIERS' NOTES

Precision methods of manufacturing oil well drilling and fishing equipment at American Iron and Machine Works Company's Oklahoma City plant were studied by 16 students from neighboring nations and far-away countries, attending the school of petroleum engineering at the University of Oklahoma. E. E. Rubac, left, vice president, is shown giving two of the students a few pointers in the making of tool joints.

Veteran Jarecki Employe Retires After 50 Years' Company Service

Charles D. Shacklette, retiring Jarecki Manufacturing Company employe, was honored Friday with a testimonial dinner at the Houston Club in honor of his 50 years' service with the Jarecki organization. The dinner was attended by 50 members of the Jarecki organization, among which were many of Shacklette's long time associates from other Jarecki stores throughout the U. S.

Charles D. Shacklette

W. Howard Pape, vice president of H. K. Porter Co., Inc., parent company of the Jarecki organization, presented Shacklette with a $50 cash bond, gift certificates from fellow employes and a testimonial plaque.

Shacklette started to work for Jarecki in 1900 in the company's oil field store at Findlay, Ohio. He later became manager of the store at Wasson, Ohio, and subsequently served as store manager and field salesman at McComb, St. Marys and Lima, Ohio.

In 1910 he opened Jarecki's first store in the Oklahoma division, at Bartlesville, Okla., and soon became district manager over the district incorporating additional new stores at Dewey and Copan, Okla., and Sedan, Chautauqua and Elgin, Kansas.

In 1913 he was transferred to the company's headquarters in St. Louis as general credit manager, at which point he remained until 1946 when the company headquarters were moved to Houston, where he was placed in charge of inventory control, holding this position until his retirement.

Three Vice Presidents Are Named Directors of Hughes Tool Company

The election of M. E. (Monty) Montrose, vice president, sales; Daniel J. Martin, vice president, engineering; and Thomas A. Slack, vice president-general counsel, to the board of directors of Hughes Tool Company, represents another step in the expansion program of Hughes Tool Company and its active participation in the oil industry.

M. E. Montrose

The addition of these top executives to the board brings closer coordination of the many commercial and engineering projects the company is undertaking in specialized oil well drilling equipment.

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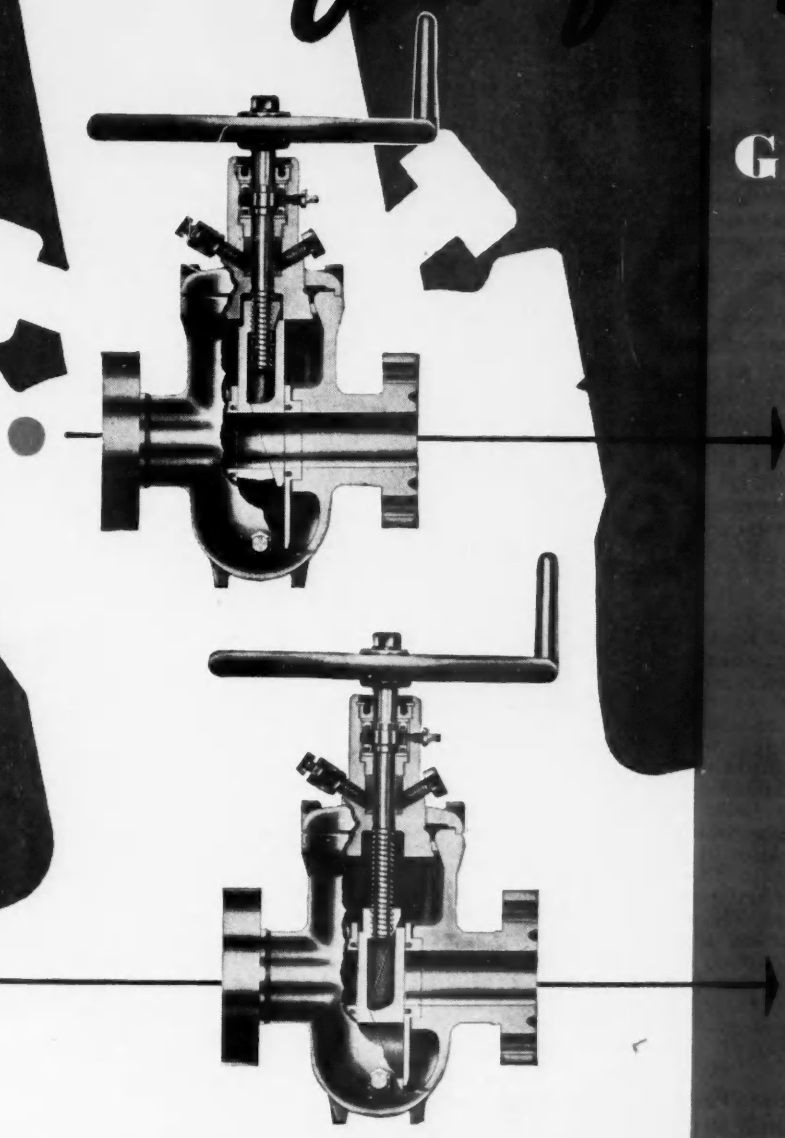
PELICAN WELL TOOL & SUPPLY CO.

P. O. Drawer 1108
Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE

An Open and Shut Case of Superiority!



W-K-M GATE VALVES

In the long run W-K-M Valves have proved their case for superiority in the oil industry. Over 80% of all the World's high pressure wells are equipped with W-K-M Valves.

OPEN

Smooth, full-bore opening entirely through the valve. No cavities or corners to collect sediment or cause turbulence. Seats not exposed to cutting or abrasion.

Free Floating operation against full-rated pressure is obtained by the W-K-M Parallel Expanding Gate. A slight movement of the wheel collapses the gate away from the seats, eliminating wedging and freezing. Double roller thrust bearings on the stem make operation even smoother.

The Expanding Gate gives a perfect seal against both seats when valve is open as well as closed.

CLOSED

Pressure Seal Bonnet requires no flanges, studs or nuts. Greater pressure gives tighter seal. Self-adjusting to temperature changes.

W-K-M Valves hold tight against pressure in both directions. The Gate expands against both seats with a slight turn of the handwheel and seals perfectly.

W-K-M SUPERIOR DESIGN INCLUDES THESE ADDITIONAL FEATURES

- Combination wipe and seal rings keep the gate clean . . . pressure out . . . grease in.
- Combination plastic-chevron packing—uses no gland or gland follower.
- Lubricant contained in entire body . . . no special lubricant required . . . seal does not depend on lubricant.
- Oversize bronze renewable seats.

W-K-M Company

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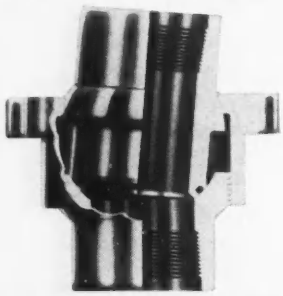
STRESS-FREE CONNECTIONS



Designed for use wherever expansion and vibration are present, the Yale "Mis-Aligning" Union provides a stress-free connection, with a positive pressure seal assured by service-proved "O-Rings."

Mating members of the union move on two arcs of a true circle, assuring perfect seating and full contact of the O-Ring, sealing surface and retaining surfaces at all times. Because mechanical compression is not required, a certain amount of "swivel" is retained. Even at its greatest mis-aligning angle, there is no restriction of flow through the union.

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EQUIPMENT and SERVICE SUPPLIERS' NOTES

New Quarters for Oil Well Supply Company's Kilgore, Texas, store were opened recently with open house ceremonies. Fred F. Murray, president, and M. F. Hazel, general manager of sales, were among company officials present. The new quarters were planned under the supervision of V. J. Waters, division manager. Frank F. Thyng is store manager.

Schlumberger Appointments Include General Sales and Area Managers

R. R. Rieke, former manager of the Gulf Coast area for Schlumberger Well Surveying Corporation, has been named to the newly created position of general sales manager. Rieke has moved his office to Schlumberger headquarters in Houston.

R. R. Rieke

E. F. Stratton, former Rocky Mountain area manager, has been moved to Houston to take charge of two former areas which have been combined to form Schlumberger's Southwest area. The area will include all operations in the Texas Gulf Coast and Southwest Texas.

After he graduated from the University of Iowa in 1936, Rieke joined the Schlumberger organization as field engineer. He worked in Pennsylvania and Canada and was district manager in Wharton, Texas, before he was named manager of the Gulf Coast area in 1943.

Rieke is president of the Houston Geological Society and is active in many other oil industry fraternities.

Lufkin Foundry & Machine Assigns Terrill to Corpus Christi District

Edd Terrill, Jr., has been appointed Corpus Christi district manager of Lufkin Foundry & Machine Company, with offices at 434 Wilson Bldg., Corpus Christi, Texas.

Edd Terrill, Jr.

Terrill was graduated from Baylor University in 1939, with a degree in petroleum geology and physical education, and completed one year of petroleum engineering at the University of Colorado, the following year. He was employed by Gulf Oil Corporation in 1940, and was petroleum engineer in the Crane district of West Texas before entering the Navy in 1942.

Terrill joined the Sales and Engineering force of Lufkin Foundry & Machine Company in May, 1946, and previous to his appointment to the Corpus Christi district was employed as sales and service engineer in the Odessa, Texas, area.

Core Laboratories Employes Buy Controlling Interest in Firm

Core Laboratories, Inc., Dallas, announced the purchase of controlling interest in the reservoir engineering firm by a group of its employes. Case-Pomeroy & Company, New York, founders of Core Lab, continue in part ownership.

John D. Wisenbaker

John D. Wisenbaker, new president of the company, stated that no major changes in the organization's services, policies and personnel are planned.

Red Top (Hydrostatic) BAILER

A QUICK, POSITIVE LOAD REGARDLESS OF FLUID LEVEL.

Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.

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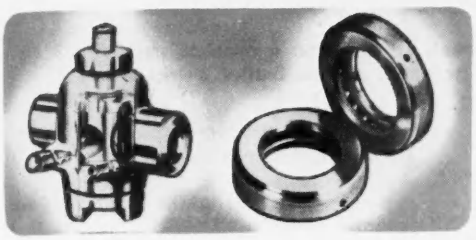
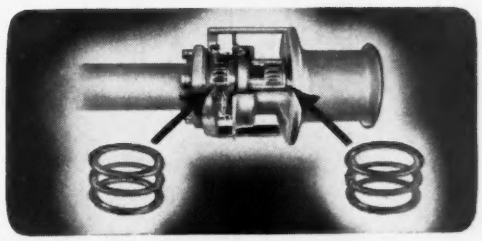
OKLAHOMA CITY, Dawson Service Co., Phone 54-7577
SERVICE, phone 54-7577, Oklahoma City.
Texas:
CORPUS CHRISTI, A. S. Baylor, Phone 2-2461.
WICHITA FALLS, Hudson-Eads, Inc., phone 2-8584.
BORGER, Nichols Tool Company, phone 350.
KILGORE, Spain Brothers, phone 2981.
SERVICE, phone 3, Turnertown; 2981, Kilgore; 2-8584, Wichita Falls; 350, Borger.
Mississippi:
NATCHEZ, Cox Supply Co.

Helping Oilfield Equipment Do a Better Day's Work

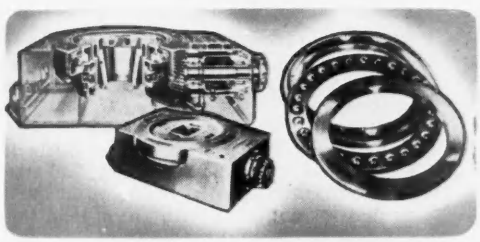
SIGNIFICANT FACT: In the last decade, as wells have gone deeper—and as equipment quality has gone deeper to meet this tougher task—Aetna oil field bearing applications have increased by more than 100%. **SIGNIFICANT REASON:** The conception and building of special bearings and parts for torture service is a basic part of Aetna's business—has been for over a third of a century. From Aetna know-how has come the solution to more than 2000 of American industry's "special" anti-friction problems. Why not tap this rich pool of experience next time YOU have an anti-friction problem? Aetna engineers are at your disposal. Write today!



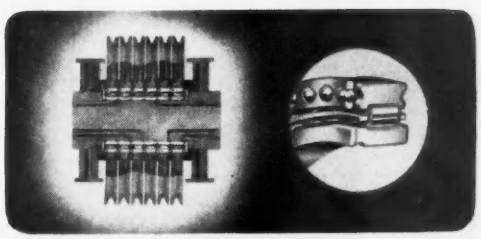
In **MISSION PLUG VALVES,** of 10,000 lb. capacity, Aetna self contained bearings make for easier assembly, assure reserve capacity and smoothness under every speed, shock and load condition encountered in plug valve operation.



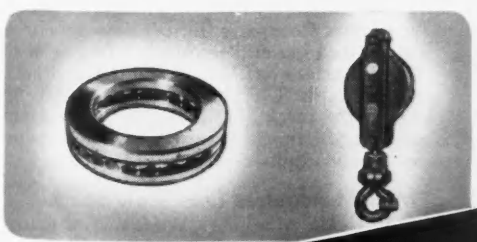
In **FOSTER CATHEADS,** two Aetna 3-piece bearings provide the high fatigue resistance, added load capacity and other operational advantages which make for longer, more efficient, more economical cathead performance.



In **IDECO ROTARIES,** the main bearing is an Aetna angular contact type—33" O.D., 3" balls, load capacity—200 tons . . . a product of Aetna's unsurpassed machining, hardening and grinding facilities for heavy duty sizes up to 38" O.D.



In **BEAUMONT BLOCKS,** (crown and traveling) Aetna's new, patented, combination cylindrical roller and ball thrust bearings divorce bearing loads into pure thrust and pure radial. Result: Width and weight of blocks are reduced, their strength and durability increased.



In **McKISSICK SAFETY BLOCKS,** Aetna one direction, flat seat, grooved raceway bearings are employed to take the shock, constant load and intermediate speeds encountered—to assure round-the-clock reliability and longer equipment life.

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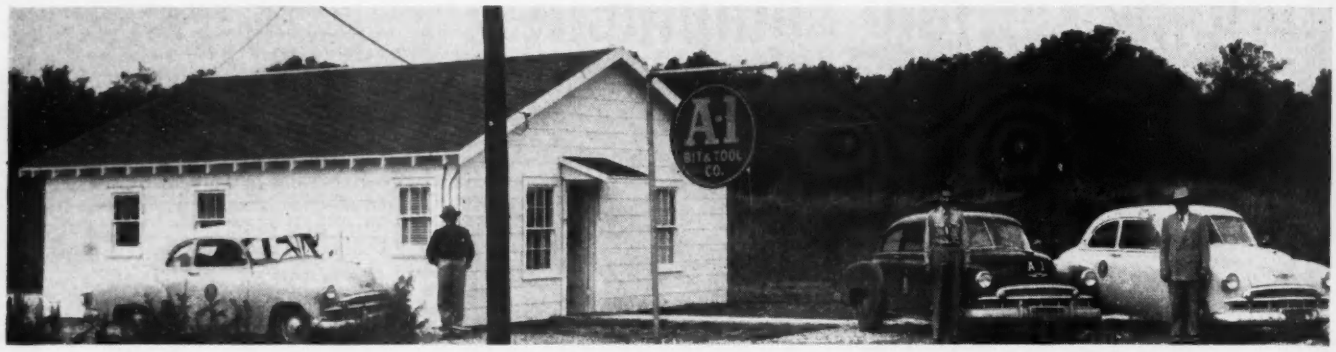
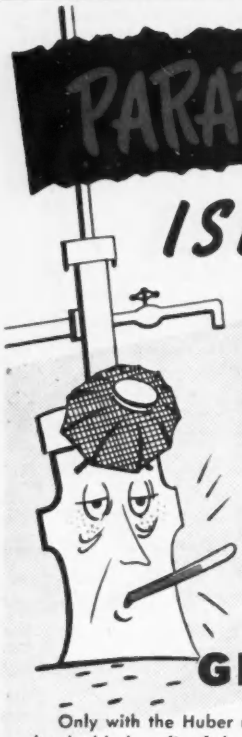


New Warehouse and Office of A-1 Bit & Tool Company, 4125 College Street in Beaumont, Texas, carries a complete stock of A-1 tools. Available for 24-hour service are, left to right, Sam Sutton, service operator; M. A. Smith, salesman; and Joe Castles, district manager.



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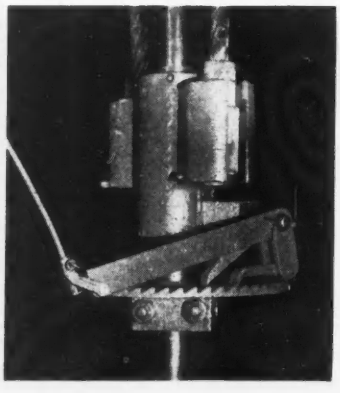
Here's good news for operators who are repeatedly spending money to remove paraffin from pumping wells. You can positively prevent the accumulation of paraffin by the installation of Huber Scrapers.

With these blades permanently attached to sucker rods in the area where accumulation takes place, paraffin is wiped from the tubing walls by the reciprocating and rotating action of the rod string. It is then pumped out of the well.

GET DOUBLE BENEFIT

Only with the Huber method do you get the double benefit of the combined rotating and reciprocating motion which wipes paraffin from the tubing in particles so small they go out in solution . . . so small they can not clog tubing, scrapers, or flow lines. Rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equalizing wear on working barrel. Get this added benefit while eliminating paraffin accumulation by installing Huber Scrapers and Huber Rotating Rod Hangers.

Install Huber Paraffin Scrapers and Rotating Rod Hanger, NOW! End costly, frequent steaming out or rod pulling to remove paraffin.



* Congestion caused by the accumulation of paraffin in pumping wells.

HUBER

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Box 831 . . . . . Borger, Texas

PARAFFIN SCRAPERS

SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

Two Sales Engineers Are Added To Mid-Continent Supply Staff

Mid-Continent Supply Company has appointed G. H. Huffhines sales engineer

G. H. Huffhines

J. C. Johnson

at the Shreveport division office, and J. C. Johnson sales engineer at Tulsa. Both have had 13 years experience in engineering.

Huffhines, a graduate of Texas A. & M. College, entered the oil supply business in 1937. He served in the Navy, and after his discharge returned to the oil business as district engineer with an oil field supply company at Shreveport.

Johnson was educated at Texas A. & M. and at a diesel school in Detroit. He had previously worked for a Tulsa supply firm.

Mid-Continent also announced the opening of new stores at Oklahoma City and Elk City, Okla. W. B. Hickman, Jr., is manager of the Elk City store, and C. R. Tatum is manager at Oklahoma City.

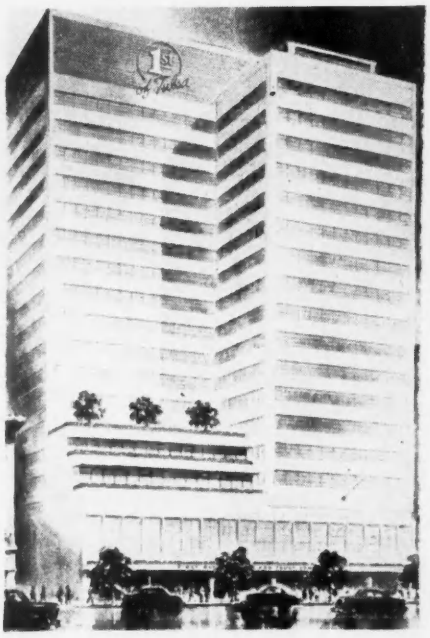
United States Steel Products Appoints General Sales Manager

Thomas M. Stinson, formerly district sales manager of United States Steel Products Company in St. Louis, has been appointed general manager of sales with headquarters at 30 Rockefeller Plaza, New York City. He is succeeded by G. P. Wardley, Jr., formerly a salesman at the Bennett Manufacturing division of the products company.

M-C-M Acquires Line Scale Stock

M-C-M Machine Works Company, Oklahoma City, has acquired partial stock ownership and management of the Line Scale Company, Inc., according to M. G. McCool, one of the owners of M-C-M. The company plans an expansion of the present plant to increase and modernize production facilities.

EQUIPMENT and SERVICE SUPPLIERS' NOTES



Skyscraper Quarters for the First National Bank and Trust Company, Tulsa, will be formally opened with an all-day celebration July 29, the bank's 55th Anniversary Day. Officers' space in the 20-story bank building is on the second floor above the banking floor, and fronts on the small roof garden area. Employe working space is on the second garden floor level. The third garden floor level begins the rentable, non-banking space in the building. Sunray Oil Corporation will lease the structure's top 7 floors.

Rockwell Manufacturing Company Adds Gas Sales Representative

Rockwell Manufacturing Company has appointed Harry J. Schneider sales representative to assist D. L. Jerman in sales work for all gas products in New Jersey, and regulator and valve lines of the Pittsburgh Equitable Meter and Nordstrom Valve divisions of Rockwell.

Harry J. Schneider

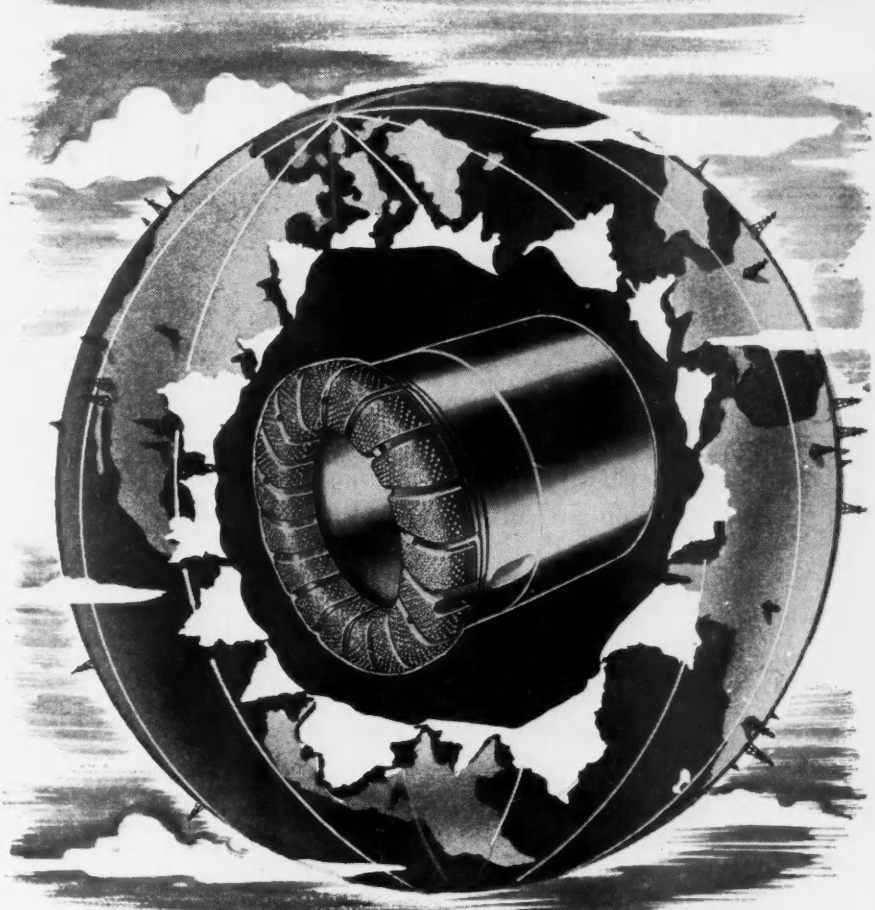
Schneider attended the Stevens Institute of Technology and was previously employed in the Gas Engineering department of Stone and Webster Service Corporation.

Export Representative Leaves For European Business Trip

D. T. (Mickey) O'Connor, New York City, is on a trip to Europe and the Near East, where he is visiting all oil producing areas on behalf of Shaffer Tool Works, M. J. Crose Manufacturing Company, Inc., Drilling & Service, Inc., Mayhew Machine & Supply Company, and Frank Wheatley Pump & Valve Manufacturer.

During O'Connor's absence, his office will be under the supervision of Ross R. Chenault, who recently joined the organization.

PROVED PERFORMANCE



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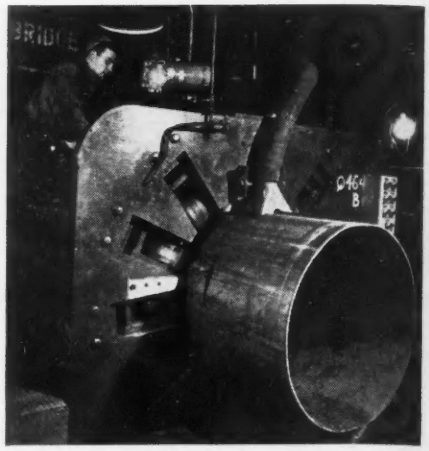
☐ Pipe Line ☐ Supply

EQUIPMENT and SERVICE SUPPLIERS' NOTES



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Major units of the mill are 16 big machines which convert wide, flat lengths of steel plate into welded pipe. Roller conveyors are used to move the semi-finished pipe from machine to machine. Among the major units in the production line are a 2000-ton hydraulic press, identified as a U-ing press because it forms the steel plate into a U shape, and an 18,000-ton hydraulic press that forms the U-shaped piece into its finished round shape.

Patterson-Ballagh Transfers Shira To Odessa, Texas, Sales District

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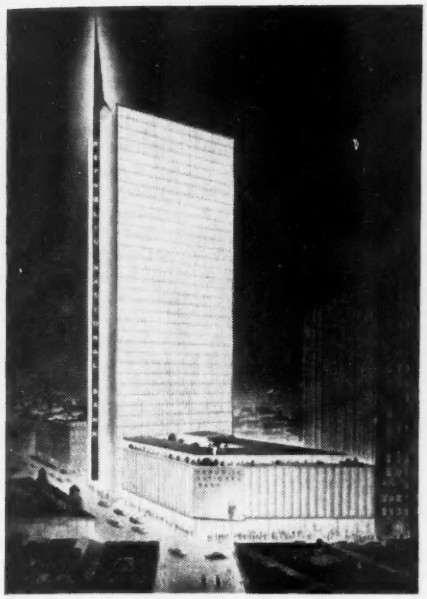

Republic National Bank will build this 36-story structure on a plot bounded by Pacific Avenue, Ervay Street and Bryan Street in Dallas.

Republic National Bank of Dallas Plans Southwest's Tallest Building

Covering more than an acre, the new office building of the Republic National Bank, Dallas, will rise 440 feet high, making it the tallest building in the Southwest. The main shaft of the building will rise 36 stories above the ground, with an additional four stories below the street level. Its tower will extend 160 feet farther.

The bank will occupy four complete floors, in addition to its safe deposit and motor-banking services in the first basement. Its main banking room will be 122 x 228 feet, and 25 feet high.

During the past 15 years, the Republic, in making available millions of dollars of loans to the oil and gas industry, has become a leading petroleum bank.

Altens Foundry & Machine Appoints Oil Field Sales Division Manager

Altens Foundry & Machine Works, Lancaster, Ohio, has appointed C. W. (Bill) Moyer as division manager, oil field sales. Moyer, who has been special sales representative for the past 2 years, will direct all national sales of Alten equipment to supply stores and assist Alten dealers with their merchandising activity.

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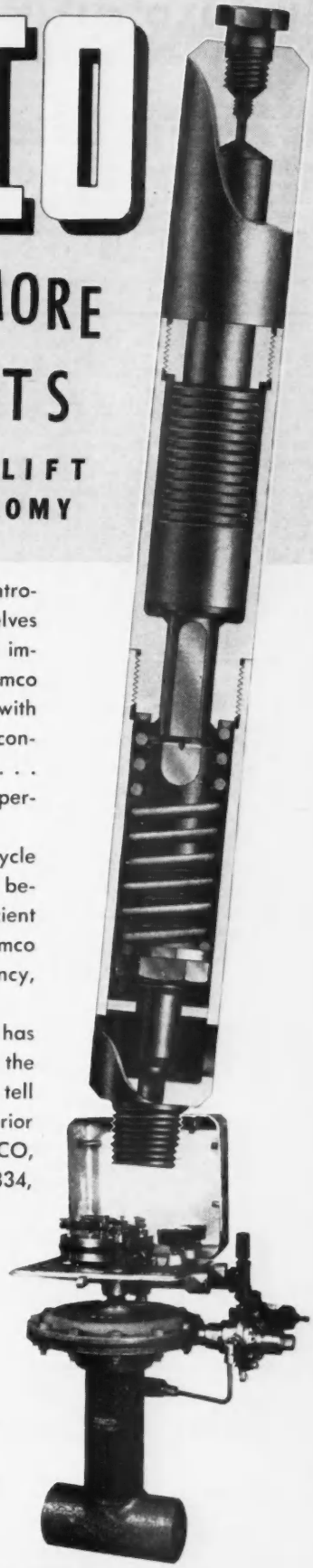
Engineer Joins Nordstrom Valve

Charles J. Kentler, Jr., has joined Rockwell Manufacturing Company as application engineer with the Nordstrom Valve division, with headquarters in Pittsburgh.

CAMCO

BRINGS TWO MORE IMPROVEMENTS

TO INCREASE GAS LIFT EFFICIENCY AND ECONOMY



When Camco Gas Lift Valves were introduced to the oil industry, we pledged ourselves to a program of continuous research and improvement. Camcoizing . . . an exclusive Camco process which pre-forms the valve bellows with 5000 lbs. differential pressure to test and condition the bellows for positive well action . . . was the original basis for the superior performance of Camco Valves.

Now Camco has developed a new Time Cycle Surface Controller Unit (right) which we believe is the finest, simplest and most efficient motor valve yet produced. The new Camco Motor Valve is designed for strength, efficiency, endurance and snappy action.

For nearly four years, Camco equipment has been in the most demanding services in the field. Write for details. We would like to tell you the complete story behind the superior performance of Camco Equipment. CAMCO, INC., 7317 Canal Street, P. O. Box 9334, Central Park Station, Houston 11, Texas.

CAMCO'S NEWEST SUCCESS

Camco now has a new dual completion mandrel, bottom hole packoff and tubing hanger which makes it easy and efficient to lift fluid from two zones through concentric strings of tubing using casing for gas energy. The first one was installed February 20, 1950. Write for complete engineering details.

CAMCO

CAMCO, INC.
7317 CANAL ST., P. O. BOX 9334
CENTRAL PARK STA., HOUSTON 11, TEX.

CAMCO *Leads* IN THE GAS LIFT FIELD

The New 1950

INTERNATIONAL OPERATIONS ISSUE

WORLD OIL now offers you the only source book on the entire world of oil. For everyone who wants to keep abreast of developments, this is the indispensable, compact encyclopedia. You'll refer to it whenever you need operating information, whenever you need data on current oil developments in any country.

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PUBLISHED MONTHLY

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☐ Drilling Contractor ☐ Individual Producer
☐ Producing Company ☐ Manufacturing
☐ Pipe Line ☐ Supply

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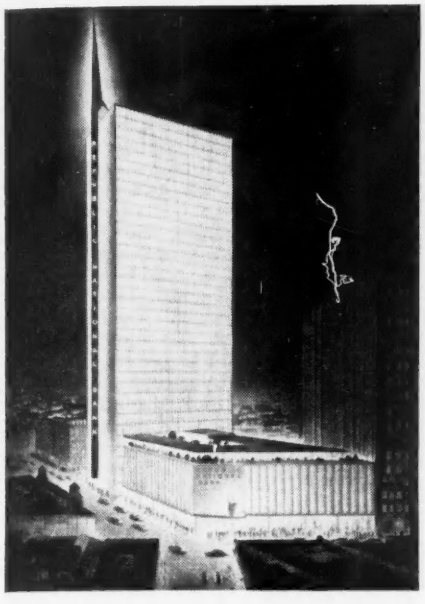

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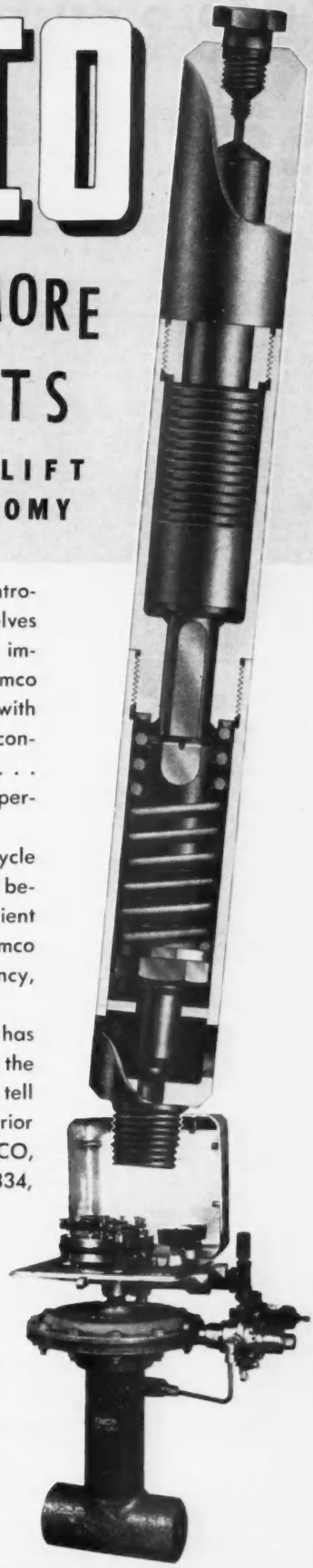

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WORLD OIL'S Trading Post

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SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

■ **WELL DRILLING EQUIPMENT.** New and used rotaries, spudders, core drills, shot hole and standard outfits. Tools, cable, pipe. Everything for well drilling. Pressey & Son, Pueblo, Colo.

■ FOR SALE (Subject to prior sale)—3 Bolted tanks, 2 in original crates and 1 assembled, (100 Bbl.). 69'-14" 57# Drive Pipe; 170'-10¾" 41# Drive Pipe; 407'-10¾" 32.75# Casing 8Rd. Thd. Smls.; 3045'-8" 24# Casing 8Rd. Thd. Smls.; 6286'-7" 23# Casing 8Rd. Thd. Smls.; 8101'-3" 9.20# Tubing Smls.; 1453'-2½" Tubing EUE Smls.; 14,226'-2" 6.40# Regular 10Rd. Thd.; 375'-⅞" Pumping Rods; 9-5" Orbit Gate Valves; 9-" Orbit Gate Valves; 3-2" Orbit Gate Valves; 3-2⅞" x 6" Parmco Combination Packer; 1-2⅞" x 6" Larkin Screw Trip Packer; 1-3" x 6" Parmco Packer; 1-2⅞" x 6" Gas Anchor Packer. M. B. Belden Office at 425 2nd St., N. W., Canton 2, Ohio, Phone 4-6147.

1 FM Diesel Engine, two cyl, Vertical Heavy Duty, Type Y, Style VA, 120 HP, 257 RPM, Direct connect to FM AC Gen. 75 KW, 3 Ph, 60 Cy, 257 RPM, 240 V with Belted Exciter Complete with circulating water pump, oil filter, oil storage tank, switchboard with O. C. B., voltmeter, ammeter, rheostats, and voltage regulator. Engine has been completely overhauled, fitted with new bearings, rings, rewound generator, etc. **$3,000 f.o.b. Montgomery, Alabama.**

COCA-COLA BOTTLING CO.

■ FOR SALE: Heavy Duty Rouse, pull down mounted on G.M.C. 6x6, 4½x5 Gardner-Denver Pump, also centrifugal, tools, bits, drill rods, etc., $4,000.00. Wm. M. Rider, 516 North 4th, Douglas, Wyo.

WANTED TO BUY

Interested in small portable double-mast rig, capable of drilling to approximately 2000 feet, with or without drill pipe. Equipment must be in good condition and reasonably priced. Preferably located on Southwest Texas. Contact:

MAKIN DRILLING COMPANY
Box 131 Phone 131
Hobbs, New Mexico

HELP WANTED

Sales Engineer

Wanted by fast growing young company making important product for protecting underground pipe from corrosion. Should be graduate engineer, preferably mechanical or chemical with experience selling to pipe line industry or oil and gas industry. Age 30 to 45. Extensive traveling. Salary and expenses. Position offers opportunity for growth with company.

Reply in confidence

Write Box 80-W

World Oil, Houston, Texas

HELP WANTED

ENGINEER WANTED

Large Company with expansion program has an immediate opening for a Petroleum Engineer experienced in production, drilling, and well completion operation in the Louisiana Gulf Coast area. Experienced with inland water operations is desirable. Rapid promotion is proposed as employee assumes responsibility. Salary will be commensurate with applicant's qualifications. All applications will be handled confidentially. Box 82-W, World Oil, Houston, Texas.

Established 57 Years

MERCHANDISE MANAGER—age up to 38 yrs. Must have M.S. degree. Old Petroleum Co., located in S.W. Salary starts at $15,000, plus bonus. Submit complete resume and picture.

DIRECTOR OF RESEARCH—age 35 to 50 yrs. At least M.S. degree in Mechanical Engineering. Previous Petroleum experience a must. Salary $10,000. Chicago location. For Manufacturer of Petroleum Instruments. Submit complete resumes.

THE ENGINEERING AGENCY, Inc.
53 W. Jackson Blvd.
Chicago 4, Illinois. Harrison 7-4056

LEASES, DRILLING, ACREAGE, ETC.

■ CUBA, MOST PROMISING OIL LANDS. Large areas, Good geology. Reasonable royalty, rental or outright sales. No production curtailment. Ready high price market, unlimited demand. Refinery available. Holdings in Pinar del Rio, Havana, Matanzas and Sta. Clara Provinces on most favorable oil structures known. Maps and information available. Cuban Oil Enterprises. Aguiar 574 St. Havana, Cuba.

SITUATIONS WANTED

■ GEOLOGIST—30 yrs. old—2 yrs. roughnecking, 7 yrs. surface and subsurface geological work with major company in Canada, U. S., and South America, desires association with aggressive independent operator, or drilling contractor who is active in wildcatting. Prefer Rocky Mtn. area, or Canada. Pertinent details and references given on request. Address Box 73-W, World Oil, Houston, Texas.

■ SUBSURFACE GEOLOGIST, successful foreign experience, seeks foreign or domestic post. Can also handle paleontology. **Box 76-W, World Oil, Houston, Texas.**

■ LAND MAN, 31, Legal Education, Abstract experience. Leased and perfected titles in Texas, Louisiana and Mississippi. Three years with Major Company, desires change, good reason. Go anywhere. Job must have good future. Box 81-W, World Oil, Houston, Texas.

■ PETROLEUM AND MECHANICAL ENGINEER, B. S. from Univ. of Okla., 1940, age 34, now employed, desires placement interview with oil company, consulting engineers or equipment manufacturer. Ten years experience in petroleum production and equipment design, specializing on oil and gas separation, emulsion treatment, gas and fluids handling and metering. Registered professional engineer, Texas and West Virginia. Resident Houston, available for interview at any time. Box 83-W, World Oil, Houston, Texas.

New Books,

Gas and Gasoline Production

Practical problems of natural gas and natural gasoline production are included in a new book, "Natural Gas and Natural Gasoline," by R. L. Huntington, professor of chemical engineering at the University of Oklahoma.

Although intended primarily as a textbook, the 598-page volume contains valuable basic technical data that make it of interest to the practicing engineer. The author treats also of the interrelation of the oil and gas industry's many branches, and historical development of gas and gasoline production and manufacturing methods. The book is profusely illustrated with graphs and drawings.

McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, $8.

Safetygraph

A new safetygraph, showing why falls are one of the most serious of all industrial accident hazards, how they occur and how to prevent them, is designed as a visual aid for training small groups. It consists of 12 spiral-bound pages, 18 by 24 inches, inserted in a leatherette portfolio. When set on a flat surface, it opens to form an easel. On the front pages, facing the audience, are colorful cartoons and duotone photographs. A safety talk for the instructor is printed in large type on the back.

This new safetygraph is the latest in a series of 16 published by the Council. One out of every four accidental deaths are caused by falls, the Council points out, and the illustrations show the hazards of ladders, scaffolds, makeshift equipment, slippery or cluttered floors, stairways, unprotected openings and horseplay.

Prices for this new safetygraph on falls, or for others in the series, may be obtained from the National Safety Council, 425 North Michigan Avenue, Chicago 11, Ill.

Industry Facts vs. Fables

A new sound slide film which factually refutes many of the rumors, myths and false stories about the oil industry is entitled "Bill Burns: Fable Killer." The film was designed primarily for oil industry employes. It points out how many of these rumors are fed by careless talk, and how they jeopardize the good reputation and well-being of the petroleum industry.

The objective of the new production is to inform the industry employes—and through them, their families, friends and the public—of the basic facts which demonstrate the progressive, competitive and efficient nature of the American petroleum industry.

The sound slide film, which uses color and cartoon-type art, illustrates some of the harmful stories and misconceptions about the oil industry, and then presents the facts which demonstrate conclusively that they have no real basis. It also emphasizes the progressiveness and competition which have enabled the industry to be a good public servant and to contribute so much to the economic welfare of the nation.

Oil Industry Information Committee, 50 West 50th Street, New York 20, N. Y., prints $20.

Maps and Movies

Unitized Projects

A pamphlet, "Unitized and Cooperative Projects in the United States," was prepared in cooperation with the Research and Coordinating Committee of the Interstate Oil Compact Commission and consists of a report made by that Committee at the May 5, 1948, meeting of the Compact held in Chicago, a bibliography on Unit Operation of Oil Pools prepared by the Technical department of the Tulsa Public Library dated March 16, 1948, and a compilation of the available information on all known projects arranged in Tables I and II with appendices to each which were assembled through various contributions from members in the industry.

These tables contain 29 cooperative projects and 128 unitized projects in 17 states. In addition four maps showing the location of projects in progress are included.

Interstate Oil Compact Commission, P. O. Box 3127, State Capitol, Oklahoma City 5, Oklahoma.

California Production

A review of the activities of the Conservation Committee of California Oil Producers, and statistical information relative to crude oil production in that state are contained in "Annual Review of California Crude Oil Production for the Year 1949."

Illustrations in the reference book include geological cross-sections, graphs, charts, and detailed maps of all California oil-producing areas.

Well completions during the past year are itemized, as well as new fields, extensions and new pools in old fields discovered during 1949. Statistical data presented in the volume include field and company group totals, information by fields and pools, and production statistics broken down by months. Production performance by 32 major and principal minor companies is also included.

Conservation Committee of California Oil Producers, 855 Subway Terminal Building, 417 South Hill Street, Los Angeles 13.

Safety Quiz

A safety quiz on film, "What's Your Safety IQ?," shows common, unsafe, off-the-job actions and conditions that can cause accidents in the home, in traffic and in recreation.

The film is available both as a 35 millimeter sound slidefilm and in a 16 mm picture, each with the same script and illustrations.

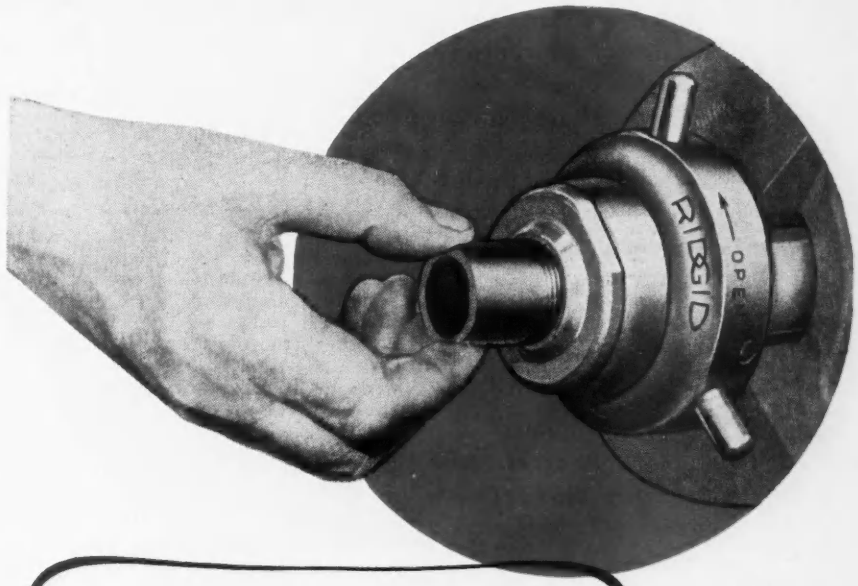
National Safety Council, 20 North Wacker Drive, Chicago 6.

Geophysics

All papers and much of the discussion presented at the conferences on the occasion of the 75th Anniversary of the Colorado School of Mines have been published in "Geophysics," Vol. 45, No. 4A of the *Quarterly*. The publication comprises 103 pages and 38 illustrations.

Department of Publications, Colorado School of Mines, Golden, Colo., $1.

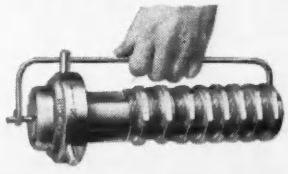
Extra-Easy Threading
OF SHORT NIPPLES



. . . "This RIDGID nipple chuck sure cuts the monkey-business out of threading short nipples."

New RIDGID Nipple Chuck fits any threading machine, power drive or vise

● Typical RIDGID worksaver advantages in this new nipple chuck—to speed every short nipple threading job! Fits any threading machine, power drive or vise—no special tools, parts or adjustments. No adjusting or changing of stop plug—it's an integral part of nipple chuck—automatically in position for use. Threaded nipple is released instantly by turn of nipple chuck—easily unscrewed by hand. Pipe adaptors for ¼" to 1½", chuck takes 2" pipe. Ask for this new fast efficient nipple chuck at your Supply House.



Free Patented Carrier for any set

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL CO. • ELYRIA, OHIO

Use O'Bannon Arrows

TO HIT YOUR PRODUCTION TARGET

Named the Arrow because of their straight and accurately finished barrel tubes and their precision construction throughout, these metal plunger pumps provide economical service in any well. Shrewd production men insist on the Arrow Pump where pumping conditions are tough.

Barrel tube and plunger combinations are offered for a wide variety of well conditions.

- *Cro-Lay barrels with Wearloy plungers for sweet wells with severe abrasion.*
- *Plain barrel tubes and Hardened Iron Plungers for less abrasive wells.*
- *For Corrosive wells, Arrow pumps made from O'Bannon Corresist give service second to none.*

Three types are available: Traveling Barrel (Illustrated); Stationary Barrel with Top Hold-Down and Stationary Barrel with Bottom Hold-Down.

All Arrow Pumps are equipped with anti-mag cages having hardened ball guides and all have lock type hold-downs.

Sizes: 2″ x 1½″, 2½″ x 2″ and 3″ x 2¾″ in carbon steel. 2″ x 1½″ and 2½″ x 2″ in Corresist.

For Better Service and Lower Lifting Cost Use O'Bannon Arrow Rod Pumps.

SOLD BY SUPPLY STORES

WALTER O'BANNON COMPANY

TULSA 1, OKLAHOMA

SQUEAKS from the BULLWHEEL

The Distinction

A man's success
Depends, you'll find,
More or less
On his frame of mind.
But a woman can achieve the same
By just depending on the frame.

Overzealous

The old engineer pulled his favorite engine up to a water tank and briefed the new fireman. The fireman got up on the tender and brought the spout down all right, but somehow his foot caught in the chain and he stepped right into the tank.

As he floundered around in the water, the engineer watched him with a jaundiced eye.

"Just fill the tank with water, Sonny," he drawled. "No need to stamp the stuff down."

The Fate Worse Than

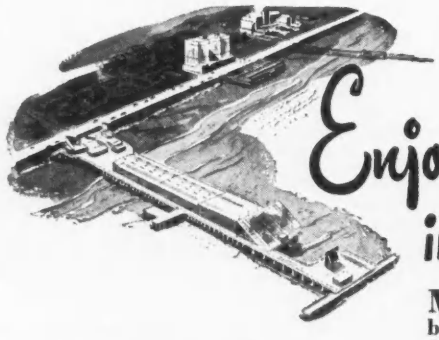
Overheard in the powder room:

"Not only has he broken my heart and ruined my whole life, but he's wrecked my entire evening!"

"Seems to be quite a bit of salt water in this sand, huh?"

Just Call Her Pogo Polly

Nickname for a one-legged virgin: Hopalong Chastity.



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Miles of white glistening sandy beach for sunning, turquoise healthful surf for swimming and fishing, top-flight name orchestras for dancing in the Pleasure Pier's beautiful air conditioned Marine Room . . . For superb hotel accommodations, on the beach there is gracious HOTEL GALVEZ with the beautiful new private swimming pool for guests, and the metropolitan HOTEL BUCCANEER. In downtown Galveston . . . HOTEL JEAN LA FITTE.

Also in Galveston . . . Coronado Courts, Miramar Courts, Hotel Cavalier, Jack Tar Court Hotel.

Use our reservation service! Call, write, or wire your nearest Affiliated National Hotel.

AFFILIATED NATIONAL HOTELS

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HOTEL ADMIRAL SEMMES . . . . . Mobile
HOTEL THOMAS JEFFERSON . . Birmingham

DISTRICT OF COLUMBIA
HOTEL WASHINGTON . . . . . Washington

INDIANA
HOTEL CLAYPOOL . . . . . Indianapolis

LOUISIANA
JUNG HOTEL . . . . . New Orleans
HOTEL DESOTO . . . . . New Orleans

NEBRASKA
HOTEL PAXTON . . . . . Omaha

NEW MEXICO
HOTEL CLOVIS . . . . . Clovis

OKLAHOMA
HOTEL ALDRIDGE . . . . . Wewoka

SOUTH CAROLINA
HOTEL WADE HAMPTON . . . . . Columbia

TEXAS
HOTEL STEPHEN F. AUSTIN . . . . . Austin
HOTEL EDSON . . . . . Beaumont
HOTEL BROWNWOOD . . . . . Brownwood
HOTEL BAKER . . . . . Dallas
HOTEL TRAVIS . . . . . Dallas
HOTEL CORTEZ . . . . . El Paso
HOTEL TEXAS . . . . . Fort Worth
HOTEL BUCCANEER . . . . . Galveston
HOTEL GALVEZ . . . . . Galveston
HOTEL JEAN LAFITTE . . . . . Galveston
CORONADO COURTS . . . . . Galveston
JACK TAR COURT HOTEL . . . . . Galveston
MIRAMAR COURT . . . . . Galveston
HOTEL CAVALIER . . . . . Galveston
HOTEL PLAZA . . . . . Laredo
HOTEL LUBBOCK . . . . . Lubbock
HOTEL FALLS . . . . . Marlin
HOTEL CACTUS . . . . . San Angelo
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1. PERFORATING—Deepest penetrating burrless bullet and jet.
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8. SONIC DEVICE*—Locates collars, liner tops, well bottom, etc.

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1. DOUBLE ACTING ROTARY JARS* and BUMPER SUBS—Reduces number of fishing jobs!
2. SAFETY JOINTS—Releases quickly in emergencies!
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Flashes from the BEACON

HONESTLY, we don't like movie "teasers" (spelled prevue) any better than you do. It's unethical, unprincipled, and downright stinky to leave folks up in the air.

* * *

BUT . . . we have a new product (exciting-type) due for unveiling in the pages of the BEACON. We hope it will appear in August. And it will be worth waiting for. We can hardly wait ourselves—and we know a little bit about it. This is the first time we have been coy about anything, and maybe it won't happen again for a long time.

* * *

A BEACON *Original*
by David Hunt

* * *

THE MAIN THING is to be getting the BEACON right along. Then you won't have to wonder . . . "Hmm. Did I miss something?" Even if we can't roll back the curtain on a new product every month, you can count on something in the BEACON you didn't expect to see. Take July. We thought it would be fun to do a story on parades. And you can almost hear the bands play when you see the pictures.

* * *

YOU HAVEN'T SEEN THE BEACON? Take a look. It's yours for a request on your company letterhead. Write to:

BLACK, SIVALLS & BRYSON, INC.
Industrial and Public Relation Division
720 Delaware
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SQUEAKS FROM THE BULLWHEEL

Victim of Circumstance

"My, my, how on earth did you come to get so completely intoxicated?" asked the magistrate.

"I got in bad company, your Honor. You see, there were 4 of us. I had a bottle of whiskey, and the other 3 didn't touch the stuff."

Multi-Purpose

The rich man employs a butler, a valet, a laundress, a cook, a secretary, and a housekeeper.

The poor man just gets married.

The Lonesome Road

The little girl's family was moving east from California. The night before the departure, she was saying her prayers and she finished up like this:

"God bless Mommy and Daddy and my little brother, Billy. And this is goodbye, God — we're leaving California."

Democracy in the Animal Kingdom

In the "Pets for Sale" classified ad column of a city newspaper appeared this item: "Our pet terrier slipped her chain and so we're peddling pups again. Cockers? Bulldogs? German Shepherds? For all we know they may be leopards."

Cut and Try Method

A fellow with the d.t.'s informed his doctor that a cat was prowling around in his stomach and demanded that it be removed at once.

Thinking a fake operation might clear up the patient's delusion, the doctor went into his act, complete with white gown, pretty nurse and gleaming instruments. Then he applied the ether and sent for a cat.

And so it came to pass that the patient awoke and blinked at a big, black cat sitting on his chest. At length he let out a sad sigh. "No, Doc, you'll have to try again. The cat that's creating all the commotion in my stomach is a *gray* cat."

"Boy—look at the size of those things!"

The One Noah Didn't Know

Opinions vary as to which is the longest word in the English language, but our nomination for that honor goes to the one that follows the statement, "And now a word from our sponsor."

Starvation Diet

The habitual drinker was at large again after taking the cure. A friend asked him how it was.

"Ghastly experience! I lived for days and days on nothing but food and water."

Steel Problems?

Call Jorgensen First

THE WRONG STEEL for the job is bound to fail — and at the wrong time. That's why it pays to use the *right* steel for the job. But when you do find yourself in a situation where you have to drop everything because of a steel problem, remember that Jorgensen renders an emergency steel service. And remember, too, that Jorgensen *can* supply the right steel for the job, because Jorgensen maintains *complete* warehouse stocks of carbon, alloy, stainless, tool and specialty steels. When *your* steel problem arises . . . *CALL JORGENSEN FIRST!*

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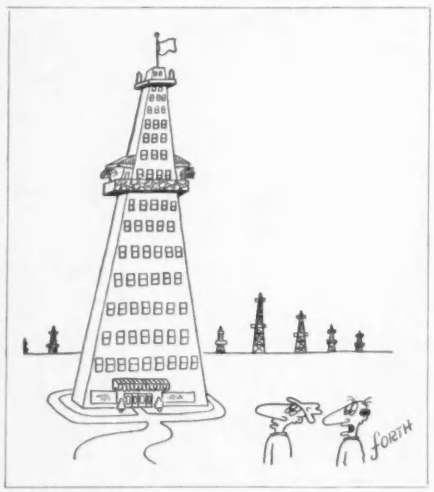
SQUEAKS FROM THE BULLWHEEL



"Rather than destroy the old derrick, I had it made into apartments."

Helpmeet

Interviewer: "What made you a multi-millionaire?"

Multi-millionaire: "My wife."

Interviewer: "Ah, her loyal help?"

Multi-millionaire: "No, it wasn't that. I was simply curious to know if there was any income she couldn't live beyond."

Traveltalk

She talked in her sleep so he sent her home to mutter.

Game Kid

The landlady brought in a plateful of extremely thin slices of bread. "Did you cut these, Mrs. Brown?" asked a boarder.

"Yes, I cut them," came the stern reply.

"All right," said the boarder. "I'll deal."

Here's How!

The farmer's daughter and another farmer's son were walking along a road together.

The lad was carrying a large pail on his back, holding a chicken in one hand and a cane in the other, and leading a goat. They came to a dark lane.

Said the girl: "I'm afraid to walk here with you. You might try to do something that's not very nice."

"How could I, with all these things I'm carrying?"

"Well, you might stick the cane in the ground, tie the goat to it, and put the chicken under the pail."

Must Be Epidemic

Man: "You say it will be a long time before your father will be fit for work again? How come?"

Boy: "Compensation's set in."

Going and Coming

A young woman took a job as a governess, then suddenly quit. Asked why, she replied: "Had to. Backward child, forward father."

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- ☐ Add name(s) to mail list, to keep us advised of other new tools and equipment
- ☐ Have representative call on us
- ☐ Specific technical information on *(list in margin below)*—